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A SCOTTISH EXPEDITION TO THE RINK GLACIER, WEST GREENLAND

By H. I. Drever and P. J. Wyllie

Introduction

One of the main objects of this expedition was a glaciological reconnaissance of the Rink and Umiamako glaciers in the northern part of the Umanak District of West Greenland. For three weeks in July and August, 1950, members of the expedition operated and explored in the area of these two glaciers which are comparatively inaccessible and, apart from their snouts, unknown. They had been photographed by the Danish Geodetic Aerial Survey during the previous summer, and we have pleasure in recording our debt to Professor Nörlund, Director of this Survey, for his very kind permission to publish two aerial photographs before completion of the new map. Before the war, the Umanak District was surveyed, on a scale of 1 : 250,000, by a Danish Ground Survey. The published maps were helpful to us, but were never intended to be accurate in detail. We have had to make a few modifications and additions based on our own direct observation in areas explored without the aid of aerial photographs which, through no fault but our own, we did not have with us in Greenland.

Since 1947, one of us (H. I. D.) had followed with increasing interest the scope and significance of glaciological investigations and results published by the newly constituted British Glaciological Society; and, to the stimulation and interest of its President, Mr Gerald Seligman, our reconnaissance last summer was in no small measure due. In *The Journal of Glaciology* the data obtained for the speed of the Rink glacier will be published. By means of its photographs, we hope this paper will convey a satisfactory impression of the nature of the country and our travelling and working conditions. The text is devoted principally to a general geomorphological study with, in addition, shorter sections on glaciology and equipment.

The expedition, although essentially Scottish, was called the 'British West Greenland Expedition.' There were seven members: H. I. Drever (Leader), F. George (Home Representative), W. Scott MacKenzie (Second-in-command), T. J. Ransley, C. G. M. Slesser, N. S. Tennent and P. J. Wyllie.* Close co-operation was maintained with a Danish Geological Expedition under the leadership of Professor A. Rosenkranz and his second-in-command, Magister Hans Pauly. That this co-operation became a very close and cordial one was due, in particular, to Pauly and MacKenzie.

The cost of the expedition was about £1150. Generous financial assistance (£550) was granted by the University of St Andrews, the Carnegie Trust and the Royal Society of London. Approximately £100 of this fund was spent on photographic film and about £50 on equipment. Each of six members paid £60 towards the cost of transport—the largest item—and food. The deficit will be covered by publishing articles and photographs.

Expeditions such as this one cannot be undertaken or carried out without help. No expedition could reach Greenland at all without the co-operation of the Greenland Administration (Grönlands Styrelse), which is responsible to the Danish Government. To its Director, Mr Eske Brun, we are very grateful. This is no mere formality: for the Danish ships have very little spare accommodation. We were made to feel very welcome. The expedition is particularly indebted to Professor Rosenkranz, Colonel Helk—who is in charge of the Photogrammetric Aerial Survey work, Kolonibestyrer Hansen of Umanak, Captain Christiansen of the *Disko*, Magister Pauly, Dr Hanssing, Dr Bögvad, Captain Poulsen, Valdemar Poulsen, the Danish residents in Umanak and Kudtligssat and many others, including the seven Greenlanders we employed. The expedition owes much to Sir James Irvine, Principal and Vice-Chancellor of St Andrews University. It is also indebted to the Director, Dr G. C. L. Bertram, of the Scott Polar Research Institute at Cambridge, to Mr R. Johnston of the Department of Geology and Mineralogy, St Andrews University, and to the many firms which supplied it with food, fuel and equipment.

Geomorphology

Geologically, the area can be divided into two great groups. The mainland and most of the two islands, Qeqertarssuaq and Upernivik, are Precambrian metamorphic gneisses and schists; the peninsulas of Svartenhuk to the north-west, Nugssuaq to the south-west and Ubekjendt Island to the west, are Tertiary lavas and sediments.

The lower Precambrian rocks are spectacularly folded into great recumbent nappes which are characteristically developed towards the icecap and heads of the fiords. The resultant foliation and schistosity tend to lie in horizontal or gently inclined planes. To the west, higher dips are more frequent.

In places, the Tertiary basalts and sediments are inclined, but, very typically, still lie in their original horizontal position. Block displacement has broken up the original continuity of the basaltic

plateau. The sound between Upernivik and Ubekjendt Islands may be a rift valley.

Faulting is not conspicuous in the Precambrian area. Step faults running approximately parallel with the line of the Kangerdluk were observed in the cliff opposite our camp (Fig. 1). The gneisses are sometimes well jointed. In general, it seems evident that the planes of foliation (Plate 6) and joints, particularly the former, are structural factors of considerable importance to the physiographical development of the area.

The journey from the expedition base at Nugatsiak (Plate 2) through the great Karrats and Kangerdluk ice-fiords was accomplished in a 16-foot boat powered by an outboard engine. The upper part of the Rink glacier was reached by a circuitous route, with the aid of sledges and skis, over the dissected area of the icecap marginal to and above its local general level, which is relatively low. The middle stretch of the Umiamako glacier was also visited and the position of its snout was triangulated from point 1253 (Fig. 1). All these journeys were entirely through Precambrian rocks.

The most interesting and anomalous general feature of the landscape is the slope downwards from west to east, from a region of spectacular Alpine grandeur (Plate 3) to a subdued, mature plateau slipping quietly into cold storage beneath the Inland Ice (Plate 1).

As in Norway, the fiords are very deep. Into the Kangerdluk the Rink glacier discharges enormous masses of ice. Loewe [1] has calculated that 18,000 million cubic feet are ejected, cataclysmically, once every fortnight. This great glacier belongs to a group which represents the fastest moving glaciers in the world. They were first observed to be exceptionally active by Dr H. Rink,[2] the 'father of Greenland Exploration,' after whom the Rink glacier (Rinks Isbrae) is named. A large number of the relatively small mountain glaciers also reach the sea.

Wager [3] has recorded dissected plateau in East Greenland which appears to represent an elevated preglacial landscape eroded, if not actually to a peneplain, at least to a late stage of maturity. Ahlmann [4] has reviewed the East Greenland region as a whole and established, on firm evidence, the widespread existence of this landscape. Members of expeditions from the University of Michigan, Demorest [5] and Carlson,[6] noted convincing evidence of irregular subglacial topography under the large Cornell and Ussing glaciers in north-west Greenland. Exceptional regularity is displayed over wide areas in the northern Umanak District (see Plates 1 and 10). The French expedition, under the leadership of Mr Paul Victor, based for the last three years on the icecap, may soon solve the mystery of the sub-icecap surface by closer and more direct methods.

In the area through which we travelled and in which we worked, there is also evidence of considerable, but rather mature, preglacial relief, including preglacial valleys, in the relatively high ground to the west. Betz [7] and Odell [8] have also postulated preglacial river-eroded valleys in East Greenland.

In any interpretation of the remarkable geomorphology of our area,

it is necessary to re-emphasise at the outset that ice can play a dual rôle. If, as here, the preglacial landscape includes flat landforms, the ice will be largely protective although not necessarily entirely immobile ; but where this surface is one of more irregular relief, considerable

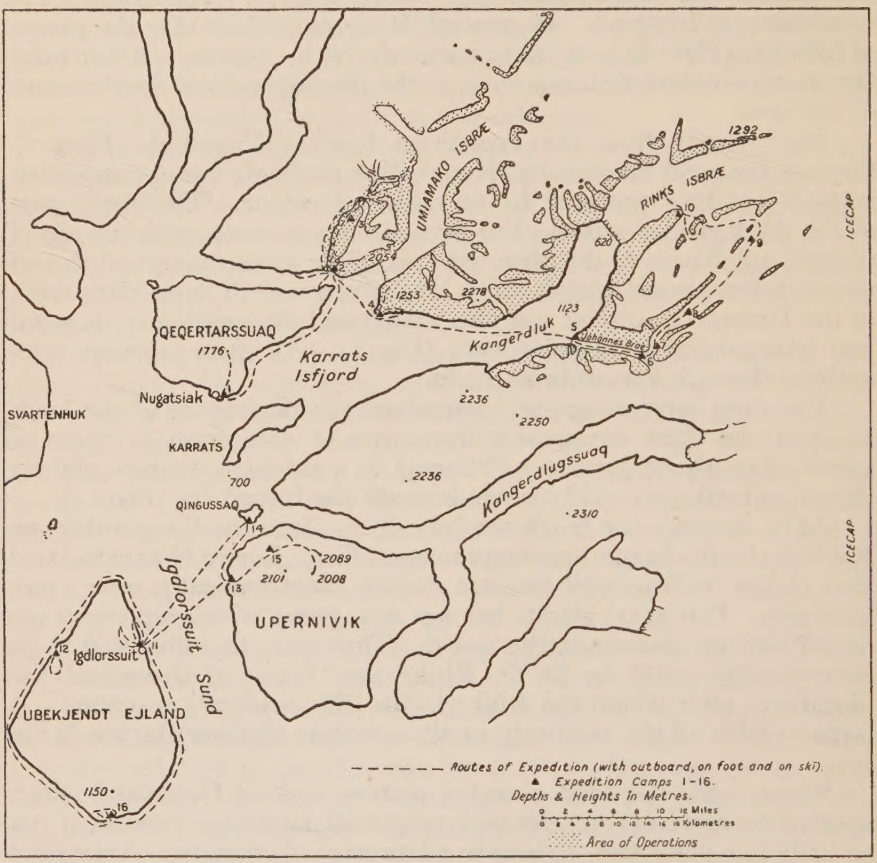


Fig. 1. The northern part of the Umanak District : based on maps of the Danish Geodetic Survey with some minor modifications in detail.

erosion is likely to occur unless the land is completely swamped by a mantle of ice. Nunataks, rising above the ice, provide the rock-tools for glacial excavation. Earlier preglacial valleys, developed along lines of weakness, will represent predetermined channels along which the ice may flow. Regional jointing or faults may thus indirectly, as well as directly, exert a controlling influence. But, as Wordie [9] found in East Greenland, the origin of the fiords appears to be mainly erosional and not tectonic. Differences in lithological structure, especially the degree of inclination of the foliation planes, will also lead to differential erosion.

Laursen [10] has made a recent study of the raised marine beaches of the Umanak Fiord area. In Nugssuaq, there is one beach as high as 230 metres above the present sea-level. Steenstrup [11] has recorded

a marine terrace at 101 metres near the Umiamako snout (Fig. 2). These beaches are evidence of the degree of depression of the land during the later Ice Age. In spite of the differences in heights of the Alpine areas and the inland plateau (Fig. 2), the change in general level

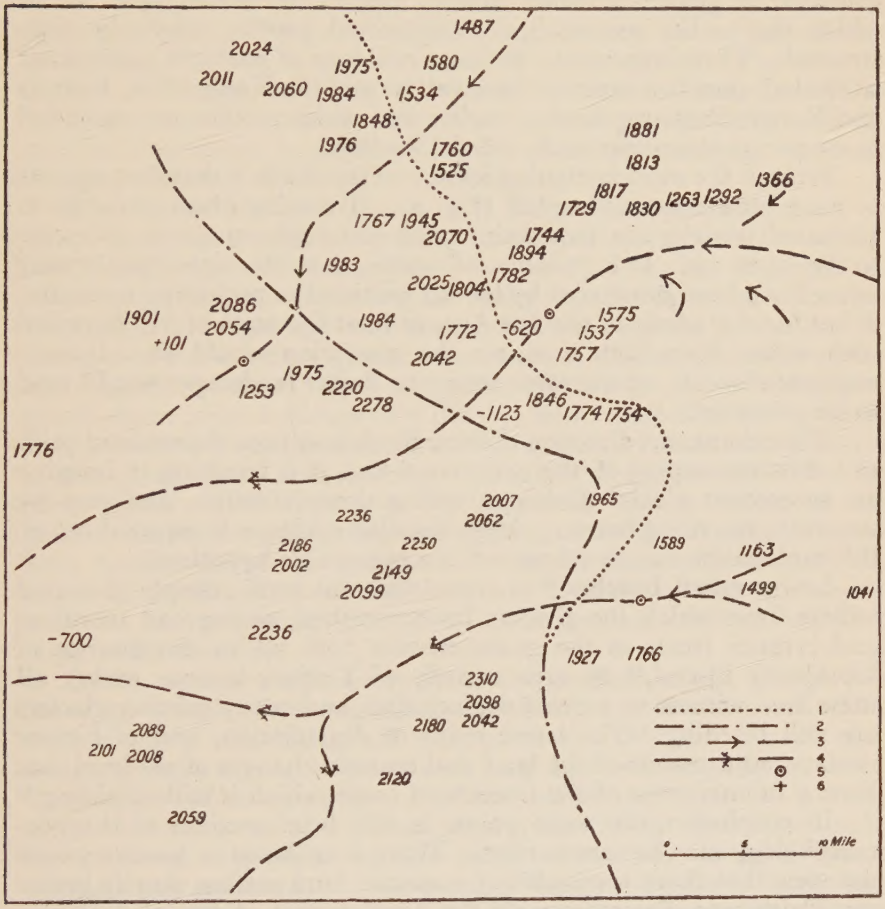


Fig. 2. Distribution of levels : heights taken from maps 71 V.1 and 71 V.2 (scale : 1 : 250,000) of the Danish Geodetic Survey.

1. Approximate line to the east of which the topography is dominantly a gneissic plateau.
2. Approximate line to the west of which the topography is dominantly highly dissected, gneissic, and alpine : the former existence of a more regular surface is revealed by the uniformity in height of the higher peaks ; towards the north is a transitional zone in which the plateau features are still conspicuous in the field.
3. Lines along which the great glaciers are at present moving.
4. Continuation lines along which the great glaciers are assumed to have moved earlier and during the Ice Age.
5. Position of present glacier snouts.
6. Raised beach.

Heights and depths (–) in metres.

downwards from west to east is fairly gradual and suggests a single, formerly continuous, but now dissected surface.

It would be very rewarding to correlate the elements and level of abrupt changes in cross-profiles of the glacier valleys, in the previously glaciated or glacier-modified valleys, and in the fiords, from all of which the earlier sequence of longitudinal profiles might be constructed. There appears to be some evidence of multiple glaciation : truncated spurs line many of these valleys and the Kangerdluk, Karrats and Kangerdlugssuaq fiords ; earlier and wider profiles are truncated to steeper or almost vertically sided U-valleys.

Perhaps the most intriguing feature of the fiords is that they appear to have been excavated uphill (Fig. 2). Towering above these great glaciated troughs are mountains 7000 feet high—majestic gateways to the open sea. It is possible, of course, that the higher peaks may never have been smothered by ice but persisted as projecting nunataks, if not for the whole of the Ice Age, at least for most of it. Supplied with stones from such a source the glaciation would be relatively augmented while, at the same time, the flatter landscapes would tend to be protected.

If the dominant direction of these fiords had been determined prior to a slow upwarping of the outer coast-line, it is tempting to imagine an antecedent glacial drainage cutting down through, and step by step with, the rising barrier. More detailed evidence is required before this explanation can be advanced as a reasonable hypothesis.

Lower raised beaches [10] at many different levels, deeply glaciated valleys from which the glaciers have vanished, widespread moraines and erratics (such as the gneiss-erratics high up in the interior of Ubekjendt Ejland,[12] an area entirely of Tertiary igneous rocks), all these bear witness to a great deglaciation, and many existing glaciers are still receding. The latest result of deglaciation, and of further isostatic adjustments of the land and eustatic changes of sea-level, has been a submergence of the Greenland coast, which is still subsiding.[13]

In conclusion, the main points in this brief account of the geomorphology may be summarised. There is evidence in harmony with the view that there was uplift of a mature land surface shortly before the Pleistocene glaciation with the development of fluvial drainage. An exceptional feature, unlike East Greenland, is that the resultant erosional surface is now higher towards the outer coastal margin. It is very tentatively suggested that this may be due to differential upwarping of the coast during the gradual, fluctuating, decline of the glaciation. It may be related to the possible rift displacement in Igdlorssuit Sound, or simply to uplift of the coast, of which movement the succession of marine raised beaches is evidence.

Glaciology

There had been one or two previous attempts to reach the Rink glacier in order to study its glaciology. In 1929, Alfred Wegener and Johannes Georgi penetrated the Kangerdluk as far as the foot of the Johannes Brae—named after Johannes Georgi. As a member of the

Franck Universal Expedition of 1932, E. Sorge was the first to obtain any valuable glaciological information.[14] In a small canoe, he succeeded in approaching the glacier snout and was lucky to escape alive. His canoe was smashed by the great wave, 60 feet from crest to trough, which is generated by a major calving. During the period when he was marooned beside the snout, he made the best use of his time by measuring its speed, a truly remarkable achievement in the circumstances. He also estimated the height of the terminal ice-cliff as approximately 100 metres. The relative inaccessibility of the Kangerdluk is expressed in the fact that, out of ten other attempts to reach the glacier by sea, only three succeeded.

We reached the Rink glacier at a point about six miles above its snout. At 5000 feet, on the journey to this point, we could look down on the great river of ice 2500 feet below us. To the east, as the glacier rose very gradually to the icecap, the rocky outcrops forming its margins diminished in height and were eventually lost under the icecap, but the margins of the northern glacier stream could still be discerned by the more highly crevassed bulges on the ice (Plate 10). The aerial photograph shows clear evidence of a distinct flow channel in the bedrock. It is separated from the main line of flow, and a reasonable inference is that it will fairly soon become a tributary distinguishable from the main glacier. The facts that (1) this is the only evidence on the glacier of irregular sub-glacial topography, and (2) the land surface a little further down the glacier is so remarkably uniform and flat, suggest that this channel was excavated entirely by the moving ice and was not preglacial in origin. This does not conform with the views of Demorest.[15]

In the region where we worked, the gradient of the glacier was found by Ransley, with an Abney level, to be only 5 degrees. The surface was a wild, turbulent mass of séracs. Most of the crevasses were not more than 4 or 5 feet wide and we could jump across them. They narrowed downwards rapidly and all had water at the bottom, so that we never saw more than about 70 feet down. Streams of meltwater flowed everywhere on the surface until they cascaded into a crevasse and continued to flow beneath the ice. In places there were large pools. The aerial photograph (Plate 10) reveals a shallow lake of considerable size, at least ½-mile long, further up the glacier.

Only six days could be spent at our camp on a moraine beside the glacier (Plate 7). The speed of flow at the centre was measured and found to be near the average speed of the fastest glacier in West Greenland and probably in the world.

An approach to the problem of the internal mechanism of glacier flow can be made by studying the crystalline texture of the ice.[16] The best results can only be obtained inside the glacier on the walls of crevasses (Plate 9), from which the glacier-crystal sizes can be recorded by a very simple method suggested by Seligman.[17, 18] The records obtained indicate that the Rink glacier crystals have a smaller mean size than crystals in a corresponding position in the very much slower alpine glaciers (personal communication from Mr Seligman).

Bad weather seriously interfered with this part of the programme.

Banks of mist appeared suddenly and spread rapidly. On the last day we experienced the full force of a föhn wind, which came howling off the icecap and straight down the channel of the Rink valley. We made the return journey to the Kangerdluk camp in good weather.

Equipment

The main special items of equipment were a new Seagull long-shafted outboard motor with clutch and spare parts, 10-foot-long canes and red cloth, and special ' pulka ' sledges with man-harness.

The Seagull motor was not specially designed for work among ice. The carvel-built, native-owned boat that we used was 16¼ feet long, with an overall draft of 3 feet 8 inches. The 6-foot beam and the blunt 3-foot 8-inch stern resulted in quite adequate protection for the propeller, which was further protected by a projection from the 4-inch keel to house the removable rudder. The boat travelled about 430 miles without mishap. No trouble was experienced with the engine.

Tripods of canes and red cloth were constructed and erected on the Rink glacier as markers for the surveyor, T. J. Ransley, who measured its speed. This was no more than a serviceable improvisation, but the idea could be extended and light cane tripods with strong coloured cloth could be made at home with a suitable anchoring device, and folded up almost ready for use. The main advantage obviously is lightness. The length of the canes, however, made the bundle an extremely awkward load.

Block-and-tackle, or a rope ladder, is necessary for the descent into a crevasse. The block-and-tackle is also necessary for hauling the boat up to safety beyond the reach of the wave generated by a calving of the Rink glacier.

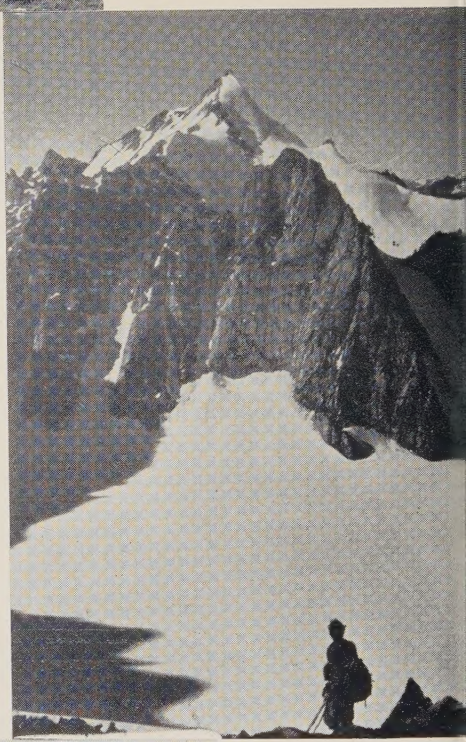
The ' pulka ' sledges (Plate 8) were purchased from the firm of Segebaden-Berg AB, Säter, Sweden. They are built to an unusual design and no report on their performance is yet available. They can be supplied either with dog- or man-harness. They are a little less than six feet in length, there are three metal-bound narrow keels and the cross-section is gently rounded. They are a type of wooden toboggan with permanently attached canvas sides which fold over the load. Some samples were sent with the recent Queen Maud Land Expedition to the Antarctic. Rigid bamboo shafts are supplied with attachments to the hauler's waist. Double ropes are also supplied with attachments for two other men (Plate 5). The cost of two complete outfits is about £14.

These sledges were hauled for over fifty miles and to a height of 5500 feet. They are light enough to be carried for short distances and can carry weights up to 150 lbs on very bad glacier surfaces. The number of haulers can be increased or reduced according to load and surface, and on good surfaces the sledges can be pulled by men on skis.

They are remarkably tough for their lightness and size. On a hard, very hummocky surface their performance was excellent and they

Plate 1. Aerial view taken in 1949 (copyright by courtesy of the Director, Danish Geodetic Institute) of the snout of the Rink Glacier and the plateau extending into, and by inference beneath, the Greenland Icecap. A great iceberg has been discharged from the snout just prior to the taking of the photograph. An unexplained feature is what appears to be a glacier-dammed lake-bed in the middle right foreground.

ate 2. Base Camp near the native village of Nugatsiak ; to Kangerdluk Fiord is almost entirely blocked by gs from the Rink glacier. Beyond Karrats Island rises 236 m. snow peak of Snepyramiden.



ate 3. An unnamed peak typical of the high Alpine raphy of Upernivik Island.

late 4. Establishing the Kangerdluk camp on a glaciated tzite ledge about 30 feet above the fiord. A sentinel peak almost sheer to 2278 m. on the north side.

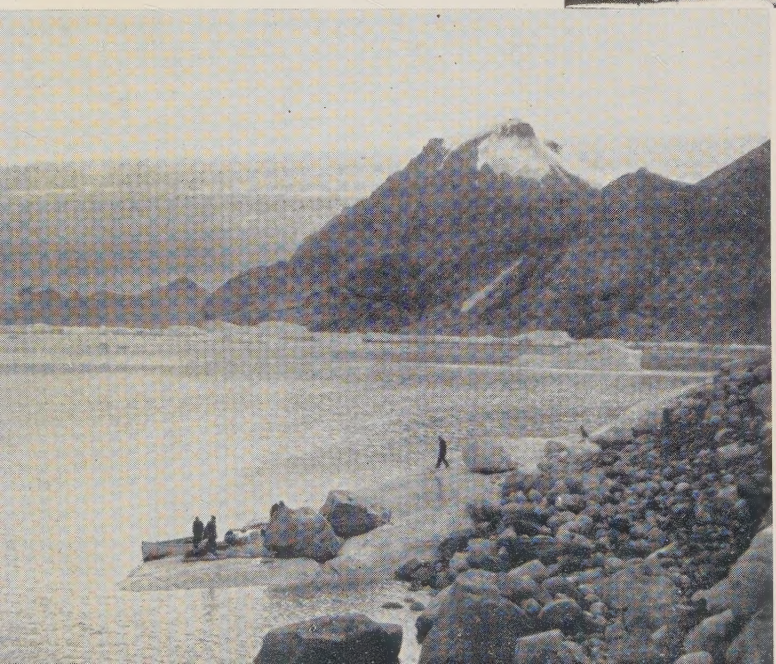


Plate 5. Manhauling a sledge on the hummocky surface of the Johannes Brae on the first stage of the journey to the Rink glacier.

Plate 6. With skis and sledges on the upper stretch of the Johannes Brae at about 4500 feet ; marginal glacier-cut cliffs of almost horizontal foliated gneiss.

Plate 7. Camp on moraine beside the upper part of the Rink glacier ; mature landscape on the north side is sharply truncated by the active erosion of the glacier and slopes gently beneath the icecap.

Plate 8. Tents and sledges used on the journey to the Rink glacier ; attached firmly to the sledges are strong canvas covers to grip and protect the load.

Plate 9. Wyllie recording glacier ice textures in a crevasse ; two others members are manipulating the tackle.

Plate 10. An aerial photograph taken in 1949 (copyright by courtesy of the Director, Danish Geodetic Institute) of the north-easterly upper termination of the Rink glacier where it emerges from the icecap ; the shallow melt-water lake must be about $\frac{1}{2}$-mile long.

were almost as good on soft snow. The surface conditions of the lower part of the Johannes Brae would have prohibited the use of Nansen-type sledges. The bamboo shaft of one pulka broke on the return journey four miles from the fiord camp. It had been badly strained when the sledge was hauled out of a crevasse. The shafts were removed and replaced by ropes; but more effort was then required as the lateral control was lacking. The harness clips should be stronger: they tended to be torn from the canvas belts.

* In this paper P. J. Wyllie is responsible for the section on glaciology and the paragraph on the performance of the sledges. Photographs, other than aerial, were taken by members of the expedition.

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THE VOYAGE OF THE *OTTER*, 1795-1797

By George Pratt Insh

"An American ship named the *Otter*"—so runs the second paragraph of a long Dispatch of 30th April 1796 from the Governor of New South Wales to the Duke of Portland, the Home Secretary—"commanded by Ebenezer Dorr and belonging to Boston, having touched at this Port to refresh his Ship's Company and to have some small repairs done to the Ship, being bound on a Voyage to the North West Coast of America and China; after having been treated here with much Civility and assisted in his Repairs as far as it was in our Power to forward them, he contrary to a very pointed Article in the Port Orders, which he had received on his Arrival, carried from hence several People, for whose Embarkation he had not obtained any Permission, and amongst this number, Mr Thomas Muir." [1]

The gaol-delivery which touched Governor Hunter to not unjustified indignation, was on a more extensive scale than one would gather from the measured condemnation of his dispatch. When the *Otter* cleared from Sydney on 18th February 1796 she carried under her hatches not fewer than sixteen convicts: a day out from port she picked up a small boat in which Muir, accompanied by two servants, had slipped out from Port Jackson under cover of night.

Hitherto historians have been interested in the *Otter* mainly on account of the part it played in the escape from the convict settlement of Thomas Muir, the young Scottish advocate, whilom a student of the College of Glasgow and one of the victims of the judicial Terror of Braxfield. Muir, however, formed one of the crowded and curious ship's company only for part of the voyage—from Sydney across the Pacific to Nootka Sound in Vancouver Island. We know a good deal about that trip across the Pacific. But we know about it only as a result of the exercise of the acquisitive instincts of the New England skipper before he reached Sydney. Of Captain Dorr's activity we obtain a vivid glimpse in the shadow of the great basalt cliffs of Amsterdam Island. Apart from the collection at this ocean outpost of the sea-otter skins which the Boston skipper held had been stored up for him by a benevolent Providence, and apart from his recruiting his ship's company from the straggling huts of the convict settlement, the two years' voyage of the *Otter* (1795-1797) has at least two more general interests: it reveals the details of the trade carried on at that time by the American ships between their north-west coast and China; it has its own little share in the story of the exploration of the Pacific. For the Scottish student, however, its main interest will probably always be its connection with the varied Odyssey of Thomas Muir.

II

According to that legendary account of the adventures of Muir, which still attracts a certain amount of not too robust credence, the *Otter* was sent by President George Washington to carry off Muir from Sydney.

A quarter of a century ago an American historian pointed out that at the time when the *Otter* cleared from Boston (20th August 1795) the international situation was such that the President was not likely to do anything of the kind. His government was then engaged in the closing stages of the negotiation of an important treaty with Britain. In these circumstances the dispatch of an American ship to carry off from a British penal settlement a convict whose trial had attracted attention on both sides of the Atlantic could hardly form part of the policy of the President.[2]

While one is quite prepared to admit the cogency of this argument, one does not feel altogether satisfied. One demands, not unnaturally, something more positive. Can one find out anything about the departure of the *Otter* from Boston ; about her call at Sydney ; about the voyage across the Pacific to Nootka Sound ; about the trade in which she was engaged ?

Through the kindness of archivists, librarians and other friends of research in California, Mexico, Australia, Great Britain, France, and Spain it is now possible to answer these questions. We know precisely who were the owners of the *Otter* ; we know the details of her size and rig ; we know the number of guns she mounted ; we know the cargo she carried ; we know the course she followed from Boston to Sydney ; we know her course across the Pacific to Nootka Sound ; and we know that at Nootka Sound Muir, far from suffering shipwreck as the legend will have it, quitted the *Otter* for an entirely personal reason to embark on a Spanish schooner that was on a coastal cruise northward from the naval station of San Blas in Mexico.

The owners of the *Otter*—here our authority is the records of the Boston Bureau of Customs—were a group of Boston merchants with a strong family flavour about it : Ebenezer Dorr, John Dorr, Joseph Dorr, Ebenezer Dorr Jr., and William Rodgers. The ship—we speak on the authority of the same record—was a square-sterned vessel of one hundred and sixty-eight tons ; her length was seventy-seven feet ; her breadth twenty-two feet ; her draught eleven feet ; she had two decks and three masts.[3] From the diary of her navigating officer we know that she carried ten guns.

When she cleared from Boston on 20th August 1795 the *Otter* carried under hatches a miscellaneous trading cargo : molasses, rum, tea, Madeira wine, port wine, and general merchandise in fifteen bales. The value of these bales was 5100 dollars ; that of all the rest of the cargo taken together was 3643 dollars. The destination of the *Otter*, as entered on the Daily Register of Clearances, and sworn to by the Captain, was " Norwest Coast America." [4]

At this period the trade on this part of the Pacific coast was mainly in the hands of New England skippers. These resolute and enterprising voyagers threaded the inlets that bite deeply into the coast of Vancouver Island, and exchanged their trade-goods for the sea-otter skins collected and cured by the Indians. From Vancouver Island the New England ships carried the sea-otter skins across the Pacific to China and exchanged them for silks and tea.

For the north-west coast of America Sydney had become a con-

venient port of call, for wood and water, on the outward voyage from Boston by way of the Cape of Good Hope. Indeed, during the early years of the settlement most of its overseas trade was carried on with the north-west coast of America. Far from being engaged in anything of the nature of a political mission, the *Otter*, in coming in to Sydney, was making a conventional call in a voyage in what had become a well-defined branch of maritime enterprise.[5]

If we desire the most emphatic corroboration that Muir's departure from Sydney in the *Otter* was entirely fortuitous we have it in his own words. When he had left the Boston ship at Nootka Sound and was the guest of the Spanish Governor at Monterey in California, he wrote, on 15th June 1796, a long letter to President Washington. Of the circumstances under which he left Sydney he gave a precise account : " . . . I was . . . to depend alone upon my own escaping and upon the providence of God.

"The *Otter* of Boston, commanded by Captain Dorr, arrived in Port Jackson, in the month of January last. The Captain agreed to give me a Passage to Boston, provided I could effectuate my escape from that Port without danger to himself." [6]

III

When on the afternoon of 24th January 1796 the *Otter* anchored in Sydney Cove, her arrival provided the culminating point in a crescendo of excitement all too seldom experienced in that remote and lonely settlement. On 23rd January the signal flag at the Harbour entrance indicated the approach of a vessel : it turned out to be the *Ceres*, a store ship from London, which had touched at the ocean outpost of Amsterdam Island and had brought away from it five Crusoes—a French officer, two French sailors and two English sailors. Next morning the signal flag indicated the approach of another vessel : the snow *Experiment* from Calcutta, which brought a large assortment of Indian goods. A few hours later the *Otter* furled her sails in the land-locked harbour.

The French officer brought from Amsterdam Island by the *Ceres* —Captain Péron—was not long in seeking out Captain Dorr.

Péron, a man of twenty-seven, belonged to Brest. In the good Breton tradition he had gone to sea at the age of fourteen. He made many voyages to the Indian Ocean. On 31st July 1792 he had left the Ile-de-France, on the brig *Émilie*, bound for the north-west coast of America.

When the *Émilie* was about to sail, news had arrived from France that hostilities between France and Britain were likely to break out soon. To be ready for whatever might happen, the owners of the *Émilie* decided that her crew should consist, in equal parts, of Frenchmen and Americans, and that the vessel should sail under the American flag. The command of the ship was given to an American, Captain Owen. To Péron fell the appointment and the prerogatives of First Officer.

Off Amsterdam Island the *Émilie* met in with the *Nootka*, Captain

Wamsley of Canton. From the island Wamsley had just taken off seven men who had been collecting the skins of sea-otters for seventeen months. The idea of leaving a party on the island to gather otter skins appealed strongly to Captain Owen. Four of his crew—two Frenchmen and two Americans—agreed to stay on the island. Péron volunteered to be Crusoe-in-Chief. The otter-hunters were to be taken off by the *Émilie* on her return from the north-west coast of America.

The *Émilie*, however, did not return. At Canton she had been seized by the commander of a British warship, who had not been deceived by the American camouflage. For forty weary months—until 16th December 1795—Péron and his four assistants remained marooned on the island. To add to the tedium of solitude and to the monotony of their toil they had the harassing experience of a cleavage in the little garrison which resulted in a species of civil war.

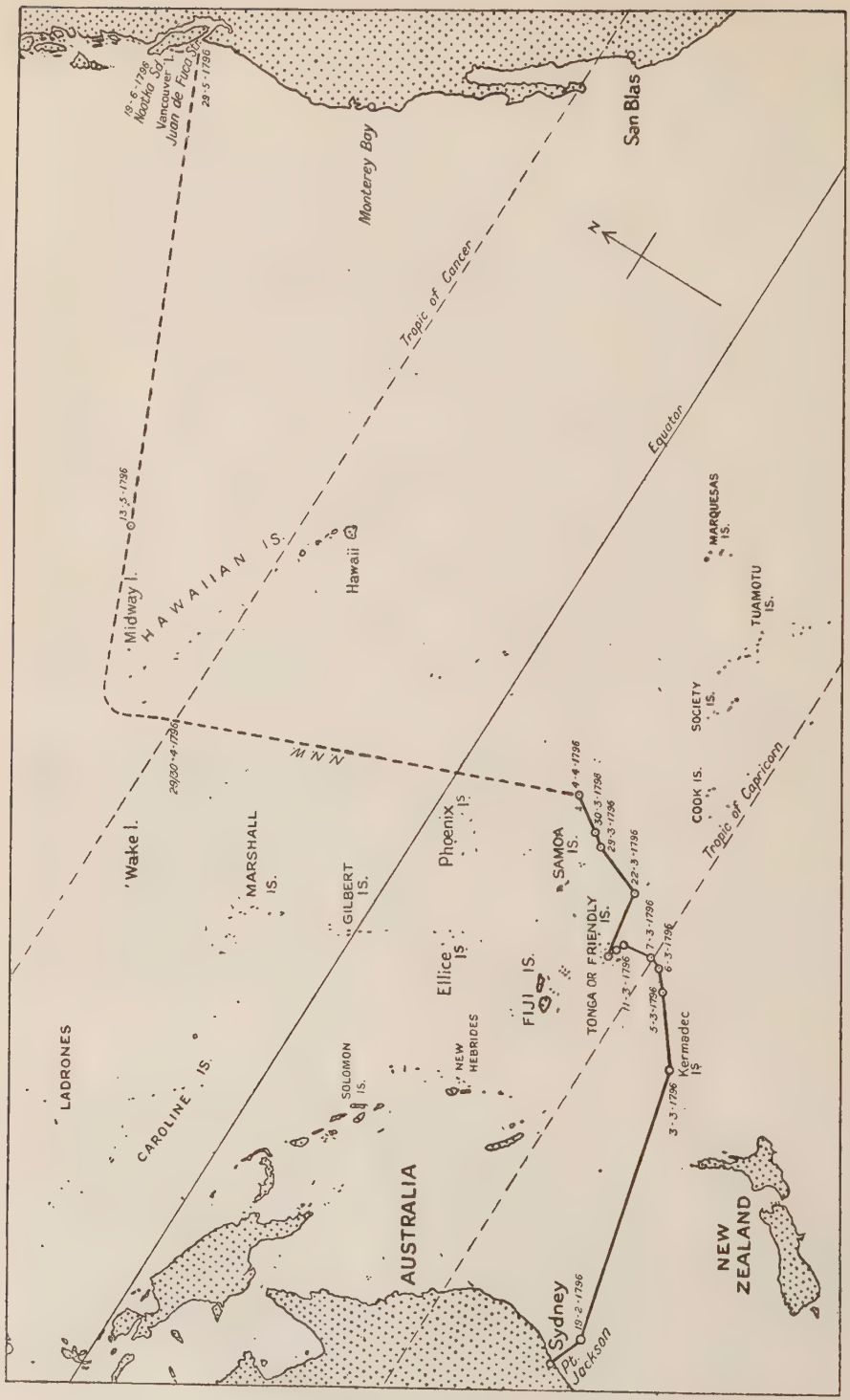
When the *Ceres* dropped anchor off the island her Captain received Péron kindly and promised him and his little party a passage to Port Jackson. He regretted, however, that owing to his heavy cargo—he was already overloaded—he could not take on board the otter skins. The skins—two thousand and seven hundred of them—had to be left behind on Amsterdam Island.

On this remote and desolate outpost they were not to remain long unclaimed. A few days after the *Ceres* resumed her voyage to Sydney, the *Otter* arrived off the island. Detecting at once, with characteristic New England perspicacity, the hand of Providence in leading him to the store of furs, Captain Dorr had them transferred at once to the hold of his ship.

Arrived at Sydney, Captain Dorr paid his official visit to Governor Hunter. Soon after Captain Péron paid his visit to the *Otter*. With Péron went the Captain of the *Ceres*. For a long time Dorr skilfully evaded the main point of the interview. Then he declared himself happy that Providence had sent him at the right moment to ensure the safety of Péron's furs : it would take some time, however, for Péron to dispose of them ; in the meantime he offered Péron the post of First Officer on board the *Otter* for the voyage to the north-west of America, to China and back to Boston. Determined not to lose sight of his precious furs again, Péron accepted the offer.[7, 8]

IV

When Captain Péron arrived at Port Jackson on the *Ceres* from Amsterdam Island, he brought with him a neatly written journal of his experiences on the island and some carefully executed drawings of the scenes among which he had been so long confined. On his voyage in the *Otter* from Port Jackson across the Pacific he kept a similar record. The only other glimpse we have of this part of the voyage of the *Otter* comes from a single sentence in a letter written at Monterey on 14th July 1796 by Muir to his Scottish fellow-reformer, the Earl of Lauderdale : " In an American ship I have traversed a considerable tract of the southern ocean, visited the lately discovered Islands, and explored some hitherto unknown." [6]



The course of the *Otter* across the Pacific from Sydney to Nootka Sound : based on the logged observations of Captain Péron.

From Port Jackson Péron, on whom devolved the navigation of the crowded little vessel, set his course eastward with the intention of passing to the north of New Zealand. In the closing days of February the deep blue of the hitherto untroubled Pacific gave place to a chilly grey, with a long swell and white-capped waves. The swell subsided on the 2nd March ; the wave-crests huddled down ; in a short time the sea was as smooth as glass, and of a whitish tint : the ship lay becalmed amid a great shoal of medusae—*bonnets flamands* Péron calls them. Night closed down on the ocean. The phosphorescent gleam that rose from the sea all around them enabled the company on the *Otter* to read even small print. At sunset they had noticed great flocks of birds winging their way to the north-east—towards, they thought, some island of which Péron's chart gave no indication. At three o'clock in the morning a strong breeze sprang up. Around them the swell once more ran high and the curling waves broke in a white smother of wind-tossed foam.

On 7th March, at two o'clock in the morning, they passed the Tropic of Capricorn. A light wind from the north bore to them the fragrance of flowers. They had a distant view of the palm-crowned ridges of some islands. That same day they saw flocks of land-birds. They steered past aquatic plants trailing on the surface of the sea. Péron's observation gave the *Otter* a position sixteen leagues to the south-east of Anamoucka (Nomuka)—in the Tonga or Friendly Islands—according to the position of this island fixed by Captain Cook.

Next day, at eleven o'clock, sailing west by nor'west, they could make out some twenty islands whose clustered palm-trees stood out dark above the deep blue of the sea and against the lighter back-cloth of the sky. On three long reefs—one to the north, one to the east and one to the west—a ragged line of white foam curdled and spouted. At noon Péron took his observation. Then, three leagues off, there surged up on the sky-line the two-crested, palm-crowned hill-tops of Nomuka.[9]

Between the *Otter* and Nomuka lay a little, low island. All round it the white breakers tossed and spouted. Through this heaving girdle of broken water shot a fleet of canoes. The flashing paddles urged them swiftly towards the approaching ship. When the Tongans had scrambled on board they gave the name of their island as Mango-Lahi.

As the ship tacked to and fro off this island another canoe, manned by five stalwart Tongans, drew alongside. One of the natives, who gave himself out to be the chief, handed to Captain Dorr and his officers, according to the custom of the Islands, some cooked fish wrapped in leaves of coco-nut palm. The officers of the *Otter* gave the chief a hearty welcome. When they told him their purpose was to make for Anamoucka (Nomuka), he clapped his hands, chortled gleefully, and hugged the seafarers to his chest.

Sending his canoe away the chief conned the *Otter* to the north of Nomuka—the breeze came steadily from the north-east. The north point of the island rounded, they steered down the west coast, keeping about two miles off-shore. They kept the lead going constantly and had resolved to bring up at the first suitable anchorage. Everywhere,

however, they found only a sea-floor of coral, at depths varying from fifteen to six fathoms. Night drew on. They had to anchor in ten fathoms, on a coral bottom to the south-west of Nomuka.

All the time they had been seeking an anchorage they had been busy trading with the Tongans. By evening the deck was piled like a market place with bunches of bananas of five or six kinds ; with water-melons, the least of which weighed twelve pounds ; with clusters of yams, sweet potatoes, oranges, pine-apples, bread-fruit and sugar-cane.

When the swiftly descending tropic night began to lower over the palm-crested hills of Nomuka Captain Dorr fired a gun. As the smoke drifted away in the still evening air the Tongans swarmed down into their clustered canoes and paddled for the white sand of that beach off which Captain Cook had twice anchored.

More than a thousand islanders had trod the deck of the *Otter*. Tall and strong, renowned both for their skill with their weapons and their readiness to appropriate anything that might take their fancy, they might well plan an assault on the little vessel and, despite the Port Jackson reinforcements, its comparatively insignificant ship's company. It was deemed wise to be on guard. At intervals round the deck were stacked muskets and sabres. The ten guns of the *Otter*, loaded with grape-shot, were massed as a battery on the poop.

V

The night, however, passed without incident. The morning gun from the *Otter* sent its echoes hurtling through the coco-palms massed above the glistening white beach of Anamoucka. The canoes, with their paddles flashing in the morning sunlight, darted out from the shore. A hundred of them bobbed about round the weather-beaten hull of the New England ship.

Traffic began again briskly. To their visitors the islanders sold cloth very finely woven from the fibres of the bark of trees and dyed in variegated colours ; ropes and fishing lines ; fishing hooks fashioned out of mother-of-pearl ; clubs, lances, bows and arrows, all of most artistic workmanship. The visitors caught a glimpse of some pigs in the canoes ; but the Tongans were by no means ready to part with these valuable animals—in exchange they wanted wares which were not included among the trade-goods of the *Otter*.

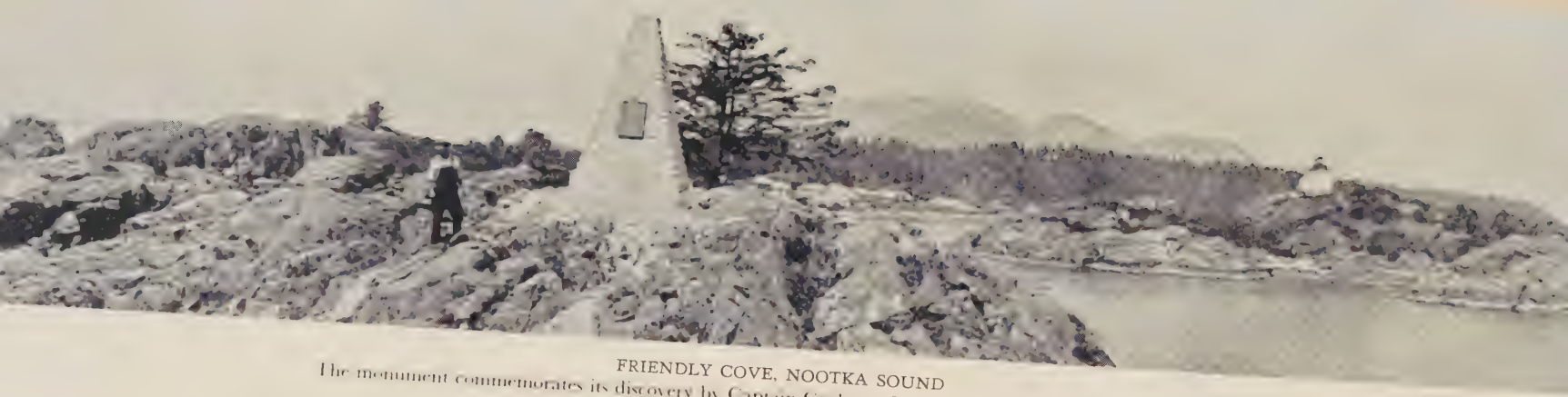
Meanwhile the quest for a good anchorage went on. In the course of taking station at different anchorages they lost one anchor, and another anchor was fouled. They set their course for the north-east. After sailing three leagues they found themselves in the midst of a great cluster of little islands, all ringed round by girdles of white breakers. They steered back between Nomuka and the first little island they had noticed on quitting their anchorage. During the night they stood off and on every two hours. The islanders of Nomuka, realising the plight of the ship in the midst of the breakers, lit a big fire on the beach to serve as a beacon.

On the 14th of March, at day-break, Péron set a course similar

ANAMOUCKA (NOMUKA): TONGA ISLANDS

Visited by Captain Cook, 1774 and 1777 ; by Bligh in the *Bounty*, 1789 ; and by Dorr and Peron, with Thomas Muir, in the *Otter*, 1796

Inset, Thomas Muir, Scottish political reformer, transported by Judge Braxfield for fourteen years, 1793



FRIENDLY COVE, NOOTKA SOUND
The monument commemorates its discovery by Captain Cook, 1778, and the Spanish occupation, 1789-1795

AMSTERDAM ISLAND, INDIAN OCEAN
Crater of an extinct volcano

to that of the preceding evening, hoping to find a channel to the north of this anchorage. At seven o'clock they passed between the little island—which on the evening before Péron had named the Door of the Labyrinth—and a line of reefs over which the water broke only a mile to the east. At mid-day, to his great astonishment, Péron made out twenty-six islands scattered all over the horizon. This new portion of the archipelago was bounded, west, north and east, by chains of reefs on which a heavy sea pounded continuously : the stretch of water enclosed by these chains was strewn with reefs, some a few feet beneath the surface of the sea, others thrusting themselves up above. Péron, however, refused to give up hope of finding a passage, and they continued to thread their way cautiously to the north-east among the breakers. Baffled after an effort of several hours they had to steer southward again.

At mid-day several canoes approached them. In one of these one of the men from the *Otter* went ashore. " Il céda probablement," opined Péron, " aux offres d'hospitalité, qui lui furent faites." The following day (15th March) five of the passengers from Port Jackson followed him. This little group of evacuees stole away to settle among the islanders of Ea-oo-wee.

On the 16th of March Péron noted with relief in his journal : " This evening we drew clear of the Friendly Islands." His self-congratulation, however, was premature. A fortnight later the *Otter* was still tacking to and fro in the vast Pacific labyrinth, with its clusters of palm-fringed islands and its long barriers of coral on which the seas pounded without ceasing.

At nightfall on 3rd April they drew near a little island smothered in clusters of coco-nut palms. At daybreak they stood in towards the shore. They noticed two men who walked along the shore, keeping pace with the ship. Others showed themselves on the crests of hillocks and beneath the palms. The determined hostility of these people convinced the officers of the *Otter* that they had not seen any strangers before. The officers felt that they might justly claim the honour of having discovered a new island—indeed a group of three new islands. Péron gave to the group the name of Otter Islands : the island to the east he called Péron-et-Muir ; that to the north he named Dorr ; the third received the name of Brown, after one of the officers of the ship.

The following day, 5th April 1796, Péron was able to record, with a finality that was not to be subjected to any further challenge, that they were drawing clear of the vast archipelago of the Friendly Islands. They set their course north-north-west. Until the 9th of April they saw many birds. By this time, however, they had lost sight of the last of the islands.

VI

The course set by Péron took the *Otter* well clear of the cluster of banks and reefs round Midway Island, the western outpost of the Hawaiian Group. During the night 29-30th April they crossed the Tropic of Cancer. At the end of May—early on the morning of the

29th—the snow-covered mountains of America replaced for Péron, Muir, and their fellow-voyagers the unsubstantial pageant of sunset clouds. There, across forty miles of sea sparkling in the morning sunlight, rose, in a vast crowded amphitheatre, the great gleaming mass of white peaks, ridges and slopes.

They made their landfall at the entrance to the Strait of Juan de Fuca, to the south of Vancouver Island. For three weeks the *Otter* tacked and reached steadily northward off the island-fringed fjord-bitten coast of the island : you can follow the carefully controlled sallies of this darting progress on Péron's chart. On 19th June 1796 Captain Dorr stood in to the spacious, sheltered channel of Nootka Sound—that remote Pacific haven whose name had suddenly become familiar, at a time of acute international crisis, to political leaders and men of affairs in Britain, Spain, France and Russia.

The sight of a Spanish schooner, the *Sutil*, at Friendly Cove in Nootka Sound caused Muir to reconsider his plans. To go on to China with the *Otter* meant that at least eighteen months must elapse before he could reach the United States. By travelling south with the schooner to the Mexican naval port of San Blas and then proceeding overland by the old highway of the treasure trains to Mexico and Vera Cruz, he might hope to get to the United States in six months. He persuaded the Spanish Captain to take him as a passenger to Monterey—where, almost a century later, another Scottish exile, Robert Louis Stevenson, was to sojourn—and thence to San Blas.

Péron, however, went on to China. His sea-otter furs were still under the hatches of the *Otter*. At Canton, however, he could stand the New England skipper no longer. He parted from Dorr. He made his way, however, on the *Grand Turc* to Boston. There he raised an action against Captain Dorr for the value of the furs carried off from Amsterdam Island. The legal debate was long and lively ; the Presiding Judge made *un résumé clair et lumineux* ; the jury gave their verdict in favour of Péron. Captain Dorr was ordered to make good the value of the furs he had carried off, subject to a deduction for the expenses of their freight. " In this affair," notes Péron, " my whole fortune was at stake : it was the reward of my sufferings and my labours that was being contested. The judgment of the court made me bless the noble and beneficent institution of the jury which in a distant country affords protection to the stranger as well as to the native."

The author is indebted to his son, Captain G. P. Insh of the School of Navigation, Aberdeen, for charting the course across the Pacific. Acknowledgments are also due to Miss Paterson of Jordanhill for the miniature of Thomas Muir ; to the Mayor of Victoria and the Provincial Archives of British Columbia for the photograph of Nootka Sound ; and to the National Maritime Museum, Greenwich, for the prints of Anamoucka and Amsterdam Island.

[1] Public Record Office. Colonial Office. Original Correspondence. Volume 13. (C.O. 201.)

[2] Masson, M., and Jameson, J. F. Odyssey of Thomas Muir. *American Historical Review*, 1949, 29 : 69.

[3] National Archives, Washington, D.C. R.G. 36, Records of the Bureau of Customs. Collector of Customs, Boston, Massachusetts. Permanent Register No. 227, dated August 20, 1795.

[4] National Archives, Washington, D.C. R.G. 36, Records of the Bureau of Customs, District of Boston and Charleston, Vol. 9. Clearance of the Ship *Otter*, August 20, 1795.

[5] Greenwood, Gordon. Early American-Australian Relations. Pp. 117-120. Melbourne, 1944.

[6] Archives General of the Indies, Seville. Estado Guadalajara, leg. 1.

[7] Collins, D. History of New South Wales, 321. London, 1804.

[8] Mémoires du Capitaine Péron sur ses Voyages. Paris, 1824. 2 vols. Vol. I : 172-259.

[9] ——, *Ibid.*, p. 261.

SOME REGIONAL ASPECTS OF NATIVE CALIFORNIA

By S. J. Jones

There can be little doubt that the study of regional geography has been stunted in its development by a tendency to limit the analysis of human activity within a given set of physical circumstances to the developments of recent times. This is particularly clear in regional studies of non-European lands where, too often though not always, discussion is confined to the results of the later phases of European migration and settlement overseas. Regional assessments of such settlement are of great value in themselves, but attempts to draw from them academic conclusions concerning regional geography may give rise to many fallacies. To obtain a complete picture of regional processes, it is clearly necessary to weigh all the evidence and, in terms of non-European lands, to give careful consideration to the regional aspects of non-European settlement. In addition to increasing the body of available data, such consideration would widen our knowledge of regional possibilities through the opportunities afforded for the comparative study both of non-European and European settlement of the same areas and of the human uses made of similar physical circumstances in different parts of the world. Further, the study of non-European activities strengthens adherence to time sequences which, in turn, should ultimately make possible the environmental study of growth and change, and should produce a dynamic geography able to cope with the question of the potency of environmental elements. California may be taken as one specific example of an area from which material of considerable importance to the regional geographer may be gleaned in a study of non-European, or native, settlement. It yields regional knowledge concerning the relationship between non-European groups and the physical circumstances in which they live; in the non-European settlement of its areas of Mediterranean climate it provides provoking contrasts with the comparable areas of Europe. Further, a closer examination of its Mediterranean climatic areas reveals certain facts that must be added to our present knowledge if a full assessment of such areas in the world is ultimately to be made. These aspects will be borne in mind in this brief exposition.

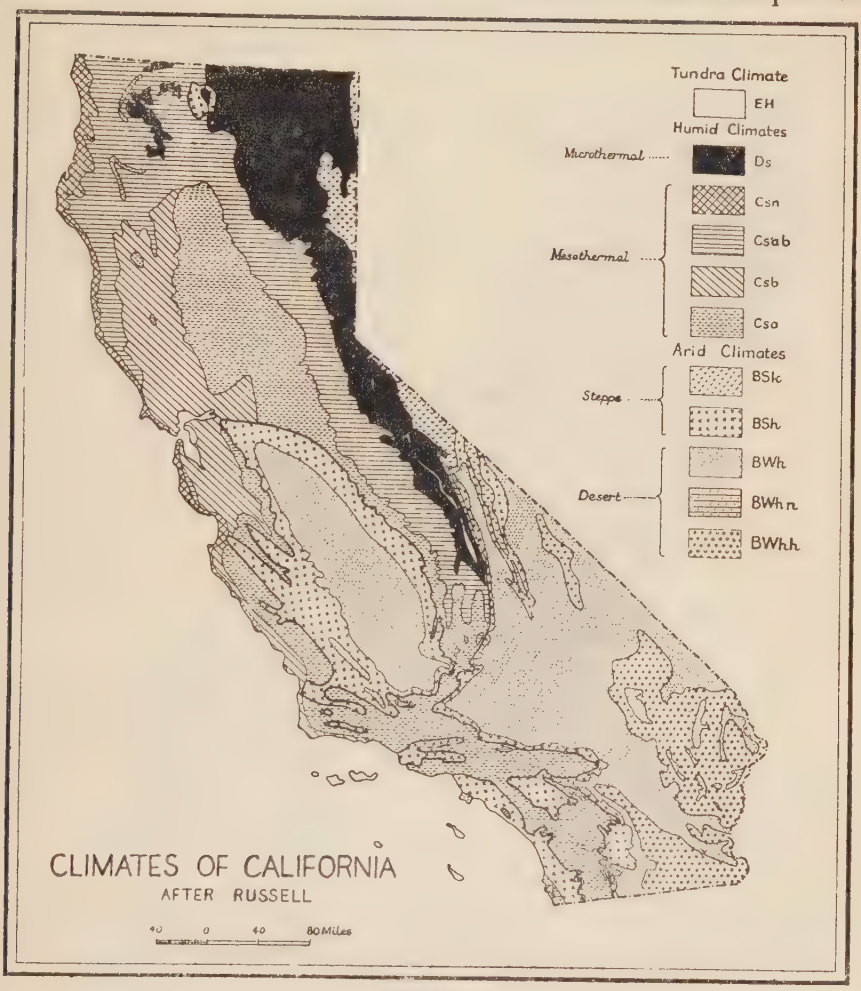
The first portion of this discussion is largely based on three maps.

Those showing the geomorphological and climatic regions of California (maps 1 and 2) [1] illustrate the regional pattern of two significant elements of physical environment. Reference to other elements not shown in maps will be made in supplementation where necessary. Vegetation, for example, must play an important part in the argument, but it is difficult to present a completely satisfactory vegetation map suited to the present purpose. This is partly due to the need for more

Map 1.

study of human interference with natural vegetation, and partly to the difficulty of showing concisely the relevant material. The importance of the acorn in the collecting economy of the Californian Indians focusses attention upon the distribution of the oak, and it soon becomes clear that the oak occurs in many regions which may be named, on a vegetation map, after some more dominant member of the vegetation complex. Similarly, a soil map has not been included because, despite the constant importance of this element, soils are not a major consideration in the present discussion of these non-agricultural peoples.

On the human side, the map showing the distribution of Californian tribes (map 3) [2] is one compiled by Kroeber. It is an attempt to reconstruct the distribution prevalent during the early stages of European entry into the area. As a reconstruction, it cannot claim complete accuracy, but there is little ground for thinking that it does not depict the essential features of the picture. The argument will not stray from the time element in this reconstruction and the question

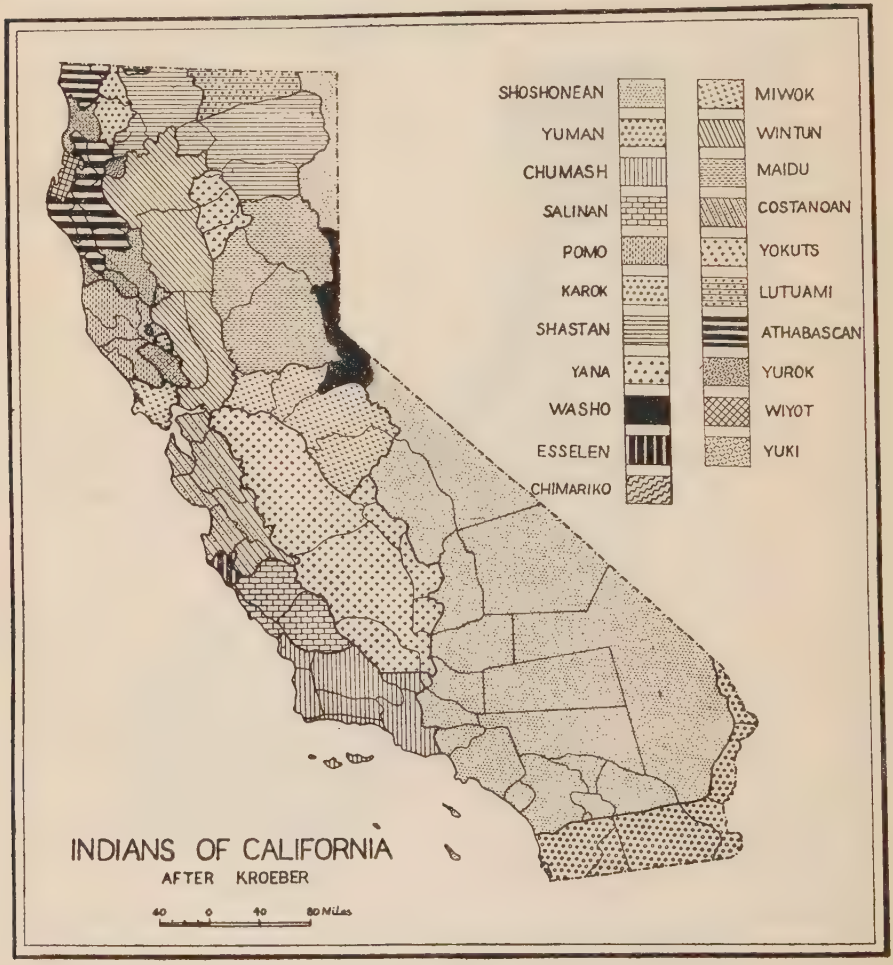


Map 2.

of the age of the distribution pattern will affect a later stage of the discussion.

The relative absence of agriculture and the complete absence of true pastoralism provide a major economic contrast between native and European California. Flood-plain cultivation of maize is found in the lower Colorado Valley.[3] Some cultivation of tobacco occurred among the Yuroks of the north-west coast,[4] and the practice of burning vegetation for the production of better wild crops, as recorded among

some Pomo groups,[5] is a reminder of the many transition stages which may occur between collecting and cultivating. The dog was the only domesticated animal: cattle, sheep, and horses are European introductions. Thus in terms of food supplies, native life was predominantly based on collecting and hunting, and it is important to remember that the California of to-day is, in the economic sense, the product of European settlement starting, in a major way, with the Spanish



Map 3.

settlement of the late eighteenth century. Several reasons contribute towards an understanding of the great absence of cultivated food plants but do not provide an absolute answer to the problem. Agricultural development in the Americas centred largely, though not exclusively, around the cultivation of maize. Whether the native habitat of maize be in the grassland surrounds of the Amazon forests or in Asia, it would appear from current available evidence that a northward spread of the plant's cultivation into North America took

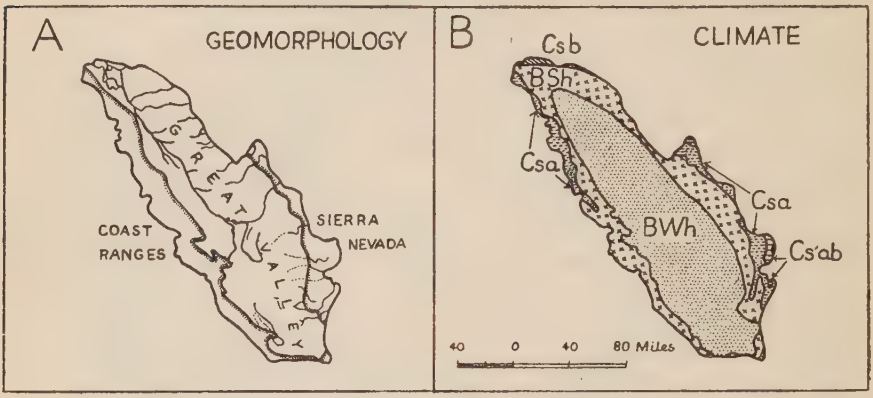
place. Such a spread would certainly face the obstacle of the desert and semi-desert areas of New Mexico, Arizona, and Southern California. That the obstacle was not insurmountable, however, is proved by the discovery of the extensive irrigation canals associated with the Hohokam cultures of the Gila valley in Arizona and by the occurrence of the flood-plain agriculture of the lower Colorado valley.

What is important for the present discussion is the fact that food plant cultivation did not spread, as it possibly might have done, into the area of Mediterranean climate in California. Fundamentally, the reason for this must be the failure of irrigation methods to extend beyond the Colorado. Without irrigation, there was, in this particular case, a further climatic obstacle. The Mediterranean climate is characterised by winter rain and summer drought ; maize thrives on summer rain. Thus the combination of climatic régime and the requirements of a particular plant made a seemingly favourable environment one of limited agricultural possibilities. This situation gains added significance when one contrasts it with the association of winter wheat with the Mediterranean climate in southern Europe, an association contributing to the agricultural basis of the great early developments in that area. Such assessment needs, however, one qualification. The absence of agriculture in the greater part of California may be linked with the efficiency of the collecting and hunting economy. Available equipment often limited early cultivation to lighter and poorer soils, and it has been estimated that California had a denser population than several of the areas of native agriculture.[6]

Within the economy of California the acorn played a basic part. It was subjected to many preparation processes, including the leaching of its tannin with hot water. The oak is prominent in the areas of Mediterranean climate but is not limited to them. It has a wide distribution within the several vegetation types and seems to be absent only at higher altitudes, in areas of great aridity, and in certain coastal spots. Despite the importance of the acorn, however, the efficiency of the economy rested largely on the wide use of the flora and fauna rendered possible by the application of certain techniques. This fundamental point has been well demonstrated by Kroeber and one cannot do better than summarise briefly his main conclusions.[7] The collecting and preparation methods applied to the acorn could be applied to the pine-nut, the buck-eye nut, and to small hard seeds. Further, the securing of plant foods was not separated by any gap of distinctive processes from that of obtaining grasshoppers, caterpillars, maggots, snails, or other molluscs. Similarly, weirs, nets, traps, and other devices for capturing fish were made with the same technique of basketry as were the beaters, carriers, and winnowers for seed. Hunting of wild fowl and rabbits also consisted quite largely of snaring and netting. The great part played by basketry in the provision of collecting and hunting equipment should be noted, as it affects a later stage of the discussion.

Within this composite picture of the food economy of the Californian Indians a good deal of local variation occurs. A comparative study of maps 1, 2, and 3 would reveal recognisable correlations

between tribal areas and both geomorphological and climatic units. Reference to the Yokuts will suffice to illustrate this aspect. In maps 4A and 4B the relative material from the previous maps has been abstracted so that the degree of correlation may be more clearly seen. In both maps, the outer boundary is that of the territory of the Yokuts.



Map 4. Yokuts Territory.

In map 4A are indicated the geomorphological divisions within this territory ; in map 4B the climatic divisions are similarly shown. It will be seen that the home of the Yokuts, of whom there may have been as many as 50 tribes, was essentially the San Joaquin valley and its southerly continuation in the Tulare Lake and Buena Vista Lake basins. To the east, it includes, south of the Fresno river, a section of the Sierra Nevada foothills, whilst to the west there is some extension into the Coast Ranges. Climatically, the bulk of their territory was either desert (BWh) or steppe (BSh), but the extensions to the hills both to east and west gave some contact with the Mediterranean (Csa and Cs'ab) climates. The prevalence of desert climate in the San Joaquin valley, now a major centre of irrigation farming, emphasises the contrast with the contemporary economic scene. At first glance, the desert-valley floor would seem to offer very limited food resources. Oaks extend some little way into the valley along the deltas of its eastern tributaries, but a large part of the valley is treeless. It is not known how many species of shrubs and grasses produced edible seeds, but probably sage seeds were eaten. The barrenness of the desert landscape was, however, counteracted to some degree by the flora and fauna of the narrow wetter belts bordering rivers and lakes. Swampy land along the San Joaquin and bordering the lakes to the south were covered by a dense growth of marsh grass and tule, the latter being the common bulrush of California. Tules from 10 to 12 feet high and 1 to 2 inches in diameter formed a belt 2 to 3 miles wide along the river. Tule seeds and roots were eaten, and tule stems used for the construction of huts, balsas, and rafts. Rivers, lakes, and marshes provided the habitat for a great variety of water-fowl, including pelican, cormorant, avocet, plover, gull, heron, tern, duck, grebe, bittern, geese, curlew, snipe. From the rivers came also mussels and

species of suckers and minnows.[8] In summer, however, the marshes were almost certainly insect-ridden and disease-infested. Climate and economic need, therefore, combined to emphasise the advantages of the transition zone of valley edge and foot-hill margin, particularly towards the better-watered Sierra slopes to the east. This is demonstrated by the denser populations south of the Fresno river, where, as previously indicated, Yokuts territory spread into the bordering hills.[9] Here pine-nuts and acorns could be collected or obtained by trading, and the contacts promoted by slight seasonal migration could result in such resources being carried into the valley proper. Thus marsh and foothill counteracted desert handicaps and the economic basis of Yokuts life accords well with the possibilities of physical circumstances.

It must be remembered that the above discussion is based upon the probable extent of Yokuts territory at a relatively late date and also upon a relatively recent expression of Yokuts economy. In terms of a dynamic study, therefore, it is not yet possible to decide whether the accordance noted is fundamentally old or new. Referring to some of their reconnaissance work in the southern part of the San Joaquin valley, Gifford and Schenck [10] were forced to conclude that the material recovered by them would seem to be as readily assignable to the last century as to the last millennium. In some more recent work near Buena Vista Lake, Wedel hazards a guess that some of the older material found by him may be from 1200 to 1500 years old.[11] It is not, however, possible to state definitely that this older material specifically represents an earlier phase of Yokuts settlement. There are some correlations but they are not absolute. It is true, however, that the location and nature of the sites excavated indicate a subsistence economy very similar to that of the Yokuts, and it is likely that the geographical concordance is an old-established feature. Further, there seem to be no grounds for postulating a change in the group occupation of the area, and consequently it is a reasonable assumption, though not a proved fact, that the Yokuts economy represents an adjustment to physical environment which has its origins considerably back in the past.

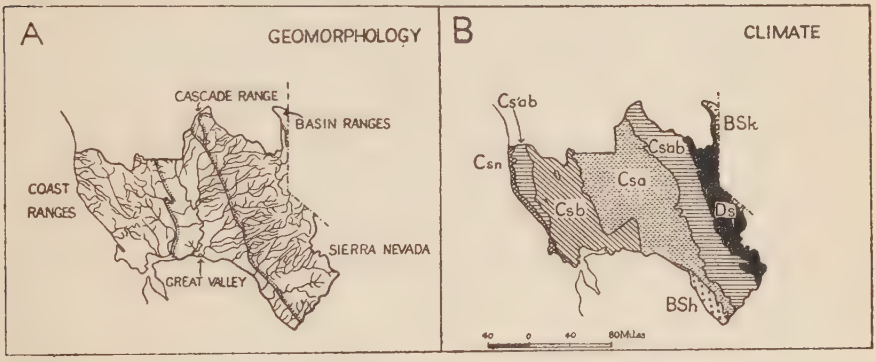
Whilst correlations between tribal economy and tribal terrain, as exemplified by the Yokuts, are of significance and value in regional assessments, they do, if regarded as being purely static, leave many problems unsolved. Fundamental among such problems is the question of the potency of the inter-relations between economy, social institutions, and physical environment. The answer to such a question may come eventually if geographical attention is increasingly focussed on the dynamic study of the growth of human economies and institutions against the relevant physical background. The greatest advances will obviously come from the study of the regional associations of emergent new economies, but an illustration of the significance of such study occurs in the regional pattern of native California. An important feature of this discussion has been the inability of the Californian Indian to break through the confines of a collecting and hunting economy even within areas comparable with the potent Mediterranean lands of Europe. To return to this aspect, it is obviously necessary to

find out whether the areas of more favourable physical circumstances in California are, or are not, associated with some enrichment of economic and social life within the general pattern.

In seeking an answer to this question, the geographer is helped by Kroeber and Klimek's studies of cultural climax in native California. The term ' climax ' is used in the sense of the culmination of a culture in relation to the culture's content and systemisation ; it includes also consideration of the area in which this culmination occurs. Its geographical significance can be judged from Kroeber's statement that ". . . the very concept of climax, or, if one will, culture centre, involves not only the focus of an area but also a culmination in time. Through the climax, accordingly, geography and history are brought into relation ; or, at any rate, the areal and temporal aspects of culture cannot be really related unless consideration is accorded to climax." [12] In his earlier work, Kroeber suggested that climaxes were distinguishable in north-western, in southern, and in central California.[13] The first two were considered as centres deriving many of their characteristics from areas outside California. By contrast, the climax in central California is a relatively independent and localised development and is, therefore, the one which can most suitably be discussed. Recognition of this climax was further helped by the statistical work of Klimek,[14] the material for his analysis consisting of "411 elements of economic, social and spiritual culture of California Indians." [15] Knowledge of both the positive and negative distributions of these elements was available. Klimek's work substantiated the distinctiveness of the central area, and suggested a division into eastern and western sub-provinces : the eastern represented by the Sierra and Plains Miwok and by the Washo, the western by the Pomo (see map 3). Returning to this problem, Kroeber[16] analysed 806 traits and concluded that culture foci or climaxes could now be territorially expressed in terms of groups or tribes instead of merely by tentative points on maps. He recognised two foci, or climaxes, within the central area. Climax I is represented by the Pomo of Clear Lake and Russian River ; Climax II by the Patwin, the Maidu, and the Nisenan of the Sacramento Valley. As the Patwin are the southern Wintun and the term " Nisenan " applies to some of the southern Maidu, a preliminary location of the climax areas can be made by reference to Map 3. These central area climaxes are relatively feeble when compared with those of north-western or southern California. Of the 806 traits considered, Climax I has only 32 traits peculiar to it and Climax II only 17 ; the two climaxes having in common a further 7 traits. The feebleness of these climaxes is understandable when one remembers that they occur within the limits of a general collecting and hunting economy, and the fact that such slight differences are definable gives them additional significance. In terms of material culture, the peculiar traits are mainly, though not exclusively, associated with basketry. If the part played by basketry in collecting and fishing is remembered, it is clear that skill in basketry had economic as well as artistic value. In terms of social culture, the distinctive traits arise mainly from the cults of Kuksu society type. These cults are based

on a secret society and characterised by the Kuksu or ' big-head ' dances. Discussion of the nature and purpose of these cults is not necessary here, but their general significance may be appreciated from Kroeber's comment that to the natives any cessation of the Kuksu ceremonial organisation " would have seemed equivalent to a general catastrophe, perhaps directly productive of a disintegration of the physical world." [17] The cults reached their most elaborate forms among the valley Maidu and the river Patwin, and amongst the Pomo of Clear Lake and Russian River. That material and social traits should thus blend to give distinctiveness to a climax is a fact of considerable importance and lends emphasis to the view that the geographer should be constantly alert to the part played by social organisation as the medium through which adjustment to changes in the use of the physical environment may be fostered or retarded.

It remains to note the geographical circumstances in which the identified climaxes developed. The boundaries of maps 5A and 5B are the territorial limits of all the groups associated by either Kroeber or Klimek with the climaxes. The maps have been drawn from the base maps in the same manner as were maps 4A and 4B. They



Map 5. The Climax Area of Central California.

require brief comment and some amplification. Climatically, it is clear that the climaxes occur within an area experiencing a Mediterranean climate, the symbols on map 5B denoting variants of the Mediterranean climatic type. This factor, however, is not peculiar to the climaxes because considerable areas of similar climate lie outside the climax limits. Nevertheless, it should be noted that the small extension of Mediterranean conditions to the north is in the area where the southern boundary of north-western cultural influence can be traced, whilst the Mediterranean portions of southern California are similarly placed in relation to other extraneous cultural elements. Climatic conditions are reflected vegetationally in the wide distribution of the oak, which occurs frequently in the ' park-land ' vegetation of the lower Sacramento Valley and is found on the slopes of both the coast ranges and the lower foothills of the Sierra Nevada. In drier portions of the Mediterranean area manzanita and other seed-bearing brush are typical vegetational elements.

Geomorphologically, the main sub-divisions are the coast ranges, the lower Sacramento valley and the western slopes of the Sierra Nevada (see map 5A). The Russian River, flowing through the coast ranges, is closely associated with Pomo development. Its series of small, enclosed valleys, separated by gorges, helps to explain the division of the Pomo into some 50 groups ; its salmon made fishing an important complement to collecting. Also within the coast ranges, Clear Lake was the other major focus of Pomo settlement. One of the few large bodies of fresh water in California, Clear Lake has been described as " one of the ideal spots for Indian residence in the State." [18] It drains by Cache Creek into the tule marshes of the lower Sacramento valley, but was more accessible from the Russian River. Its fish and water-fowl adequately explain its significance.

The western portion of the lower Sacramento valley and the tule marshes bordering the river were occupied by the Patwin (southern Wintun), who settled also along the northern shore of Suisun Bay and along part of the northern shore of San Pablo Bay, probably as far west as the divide between the Sonoma and Napa valleys. The tule marshes have much the same significance as they have in the San Joaquin valley. Knoll sites near the Sacramento provided good winter bases for fishing and for the snaring of ducks and geese. In summer, they were largely abandoned for the drier hill-slopes with their acorns and seeds. The importance of the marsh belt, with its dominant tule or bulrush, will no doubt recall the early physical setting of the lower Nile valley. The eastern portion of the Sacramento valley and the adjoining foothills of the Sierra Nevada were held by the Nisenan or southern Maidu. This territory is essentially the drainage basins of the American, Bear, and Yuba rivers. With their settlements mainly on the river divides, above the gorge valleys, the Nisenan could command much the same food resources as the other climax groups.

It would seem, therefore, that two aspects of the physical environment are important in the climax areas in terms of an assured food supply. Within the variations of Mediterranean vegetation there occurred a goodly supply of acorns and seeds ; within the variety of terrain, rivers, lakes and marshes provided good fishing and an abundance of water-fowl. Ultimately, to achieve a regional assessment in a dynamic sense, it will be necessary to attempt to resolve the relative importance of seed-collecting, linked with vegetation and climate, and of fishing and snaring, so closely linked with drainage and terrain. For the present purpose, however, the strong development of both in the climax area must suffice.

The identification of a cultural climax, however feeble it may be, which can be studied in relation to its physical setting does give some clue to the potency of environmental elements. Further light on the problem would be shed if the emergence of significant culture traits could be approximately dated. Unfortunately this cannot be done in California, but one or two points bearing on this matter should be noted. On the balance of available evidence, it seems likely that in this specific case the climax is relatively old ; it would certainly not

seem to be a recent development. In terms of recent changes, however, Heizer has rightly pointed out that the period 1780-1850 was one of cultural change and adjustment among the coastal and interior valley tribes of California, consequent upon Spanish penetration and mission building.[19] He suggests that there are archaeological grounds for identifying in this period significant developments in material culture in a natural refuge area such as the delta region of the Sacramento river. He would, therefore, postulate a " culture hearth " in the delta region, to some extent in opposition to Kroeber's climax among the Patwin of the lower Sacramento valley. To avoid ambiguity, it should be noted that the shift of centre suggested by Heizer falls within the climax area which has been discussed and that there is no ground for thinking that the degree of change and movement was sufficient to invalidate Kroeber's map of tribal distributions. Whilst future work may substantiate Heizer's opinions concerning the period of cultural change, it seems most likely that the climaxes referred to in this paper are older than the centres of relatively late change noted by him. One is influenced in this decision by the strong development of the Kuksu cult among the Patwin which, quite rightly, is not considered by Heizer in his assessment of purely material culture.

Also pertinent to this discussion is the relative absence of long-distance communication among the climax groups. These peoples show in an emphasised form the contrast between North America and Europe in the evolution of means of transportation. The horse and wheeled vehicles were absent. Further, California was beyond the limit of dog-travois travel in North America.[20] Between Cape Mendocino and Cape Concepcion true sea-going craft were not used,[21] and water communication was largely limited to tule balsas on river and lake. Heizer rightly suggests the acceleration of change with the Spanish introduction of the horse, but prior to this, movement and culture-contacts must have been limited. In this respect, Kroeber is probably right in judging Pomo communities to have been " at once narrowly localised and highly sessile . . ." [22] In such circumstances, the climax may have been long established but the period of its growth cannot as yet be fully identified.

The most important conclusion of this study is that the Mediterranean area of California, whilst lacking the vigorous growth of material and social culture found in the Mediterranean lands of Europe, did nevertheless produce a climax within a collecting and hunting economy. The climax was feeble largely because there was no emergence of new economies, but its occurrence will be important in a final analysis of regional elements in Mediterranean lands. It must be clear, from the many aspects of the problem introduced in this paper, that no direct comparison between Mediterranean California and Mediterranean Europe is possible. Nevertheless, it is hoped that the assembling of such ' case-histories ' will eventually provide the data from which conclusions may be drawn. Regional studies of non-European peoples must provide an important body of the data from which sound premises concerning regional geography may be derived. Wherever possible, such studies should be dynamic in

character, should note the rate of growth and change, and so add to our knowledge of the operative power of environmental elements.

[1] The geomorphological map is based on a Geomorphic Map of California, prepared by Olaf P. Jenkins, 1938. This map is included on Sheet No. III Southwest Coast Section of the Geologic Map of California by Olaf P. Jenkins. Published by the State of California, Department of Natural Resources, Division of Mines, San Francisco.

The climatic map is based on R. J. Russell's map of Climates of California. This map uses Köppen's system but includes some modifications which Russell considers suitable to Californian conditions. See *University of California Publications in Geography :* 1926, Vol. II. Climates of California, R. J. Russell.

[2] Smithsonian Institution. *Bureau of American Ethnology. Bulletin* 78. A. L. Kroeber, Washington, 1925, Plate I—Indians of California, by Stocks and Tribes. Further references to this publication will be abbreviated to Handbook, Kroeber.

[3] *Idem*, p. 735.

[4] *Idem*, p. 88.

[5] Gifford, E. W., and Kroeber, A. L. Culture Element Distributions : IV—Pomo, Item 338, p. 138. *University of California Publications in American Archaeology and Ethnology*, 1935-37, Vol. XXXVII.

[6] *Idem*, 1939, Vol. XXXVIII. Cultural and Natural Areas of Native North America. A. L. Kroeber, Table 9. Population Densities by Major Areas, p. 143.

[7] Handbook, Kroeber, pp. 523-525.

[8] Gifford, E. W., and Schenck, W. E. Archaeology of the Southern San Joaquin Valley, California. *University of California Publications in American Archaeology and Ethnology*, 1926-28, Vol. XXIII. This paper contains a good description of the valley on which some of the above comments are based.

[9] *Op. cit.*, in footnote 6. Map 19—Population Densities in Native California, by Gross Areas of Ethnic Groups, p. 154.

[10] *Op. cit.*, p. 118.

[11] Wedel, Waldo R. Archaeological Investigations at Buena Vista Lake, Kern County, California. Smithsonian Institution. *Bureau of American Ethnology. Bulletin* 130. Waldo R. Wedel, Washington, 1941, pp. 144-145.

[12] *Op. cit.*, in footnote 6, p. 228.

[13] Handbook, Kroeber. P. 899.

[14] Klimek, S. Culture Element Distributions : I. The Structure of California Indian Culture. *University of California Publications in American Archaeology and Ethnology*, 1935-37, Vol. XXXVII. Pp. 1-70.

[15] *Idem*, p. 20.

[16] Kroeber, A. L. Culture Element Distributions : III—Area and Climax. *University of California Publications in American Archaeology and Ethnology*, 1935-37, Vol. XXXVII.

[17] Handbook, Kroeber, p. 383.

[18] *Idem*, p. 224.

[19] Heizer, R. F. The Direct-Historical Approach in California Archaeology. *American Antiquity*, 7 (2), Part I, p. 120.

[20] Wissler, C. The American Indian. London : Oxford University Press, 1938. P. 29, Fig. 7. Distribution of Animal Transport.

[21] Handbook, Kroeber, p. 243.

[22] *University of California Publications in American Archaeology and Ethnology*, 1935-37, Vol. XXXVII. Culture Element Distributions : IV—Pomo. E. W. Gifford and A. L. Kroeber, Part II. Analysis. A. L. Kroeber, p. 247. Kroeber further notes that : " The sum total of Pomo community movements of which we have knowledge, historical, legendary, or inferable, is only four or five ; and none of these involved more than a few miles."

SOME SCOTTISH RIVER-CAPTURES RE-EXAMINED

II. The Diversion of the Tarf

By David L. Linton

The Tarf Water is among the most remote of British streams. The only part of its course which is at all frequently visited is its confluence with the River Tilt where it is crossed by the bridge which carries the footpath linking Blair Atholl, a dozen miles to the south, with the hamlet of Inverey on the Upper Dee, some eleven miles to the north. Few are the pedestrians who are likely to turn aside from this path to explore the rest of this stream which flows eastward for a matter of nine miles through a very widely-open and rather desolate valley set high in the heart of the Grampians. On the northern side this valley is bordered by what is now the main Grampian watershed followed by the Perth-Aberdeenshire county boundary ; on its southern side is the massive round-backed ridge that culminates in Beinn Dearg (3304 feet). But if the bounding ridges are high so also is the valley floor (1600 to 2200 feet) and the general aspect of this valley is rather shallow, open and tame. It becomes interesting only in its lowest section where, for more than a mile, the valley is relatively constricted and finishes up by descending the last 200 feet to the Tilt in as many yards over the two Falls of Tarf (Plates 2, 3). At the same time the west to east direction of flow is forsaken for the south-westerly direction of the Tilt—a change of some 130°. This double discordance of level and direction strongly suggests that the Tarf has been diverted by the Tilt, and when it is remembered that the Tilt is a stream whose course is determined by one of the most pronounced zones of faulting and shattering in the Highlands it would seem almost a self-evident case.

This, however, is by no means so. The diversion was first discussed by Bremner in 1912 [1] and his views were accepted in the account given a few months later by George Barrow in the geological survey memoir.[2] Bremner alluded to the matter again in 1919, mentioning " some slight reservations," [3] and took it up for the last time in 1944 in a brief paper which the present writer strongly recommends his readers to turn back to.[4] In that paper Bremner adduces almost all the field evidence known to-day ; the pieces of the jigsaw puzzle were virtually all in his hands and had it not been for what seems to the writer a notable misinterpretation of one of them Bremner might not only have explained satisfactorily the phenomena of the Tarf " capture," but have been led to realise the general importance of the over-riding and ultimate breaching of watersheds by ice which was mentioned in the first part of this article.[5] As it was, his preconceptions, in which we may detect the influence of the views of George Barrow, led him to misinterpret the matter both in the large and in detail. It is, therefore, desirable to go over the ground again, beginning at the beginning.

The Consequent Tarf and its Northward Diversion

The Tarf has the eastward flow of the Garry which parallels it to the south, and of the Upper Dee and its continuation the Geldie which

parallel it on the north. Both the Garry and the Geldie-Dee have been claimed as consequents and it would seem likely that the original Tarf was of the same family. Moreover, the subdued and mature aspect of its valley is entirely in keeping with the view that the Tarf is an early element of the drainage of the area. Further, Bremner has pointed out that this mature valley is continued westward beyond the present Tarf source. To-day the Tarf heads in a peaty flat north of Beinn Dearg. The valley, however, continues without interruption for half-a-dozen miles into Gaick Forest as a longitudinal depression occupied by headstreams of the Bruar Water and the Tromie. Bremner was undoubtedly right in regarding these as dismembered remnants of a former western extension of the Tarf.[6] Part of the dismembering he attributed to post-glacial capture, and some of the changes he regarded as certainly pre-glacial. But whatever view may be taken about the chronology of these events it is at any rate certain that they all belong to the present erosion cycle, since the former Tarf valley can still be traced as a continuous feature in the present landscape.*

Towards the east matters are quite otherwise. Beyond the confluence of the Tarf with the Tilt there is no trace in the present landscape of any valley which might have carried the waters of the Tarf eastward toward the coast. Instead, a great mass of high ground stretches from Beinn Iutharn Mhòr (3424 feet) to Glas Maol (3502 feet) and it is not until we go eastward as far as the Water of Unich, draining to the North Esk, a matter of over twenty miles from the Tilt, that we come to any high level valley that might be suspected of being a beheaded remnant of a former lower Tarf.

This, however, is no matter for surprise. The line of the early Tarf is crossed obliquely, as has already been noted, by a zone of marked weakness which is partly developed along soft schist outcrops and partly along the Glen Tilt fault and associated shattering. Along this SW-NE line some early development of subsequent streams was to be expected, and the absence of any possible eastward continuation of the Tarf is a clear indication that such streams did in fact arise and that one of them effected capture of the Tarf before the present erosion cycle began. Capture might, presumably, have been effected from either end of the zone of weakness, but it is quite clear on the ground that it was actually achieved by an outgrowth of the Dee, the nearer of the two trunk streams.

That the Tarf had once joined the Dee was early recognised by both Bremner and Barrow. Bremner noted in 1912 that the map reveals that the present headstreams of the Tilt all make upstream junctions with the present river. The burn known as An Lochain comes in from the south and bends through 125° ; the Gleann Mòr burn comes in from the south-east and bends through more than a right angle ; the Tarf comes in from the west and turns through 135°. He interpreted these peculiarities as indicating that all three streams

* It is worthy of note that this reconstruction brings the original head of the Tarf to the same line as the reconstructed heads of the Don, Feshie-Geldie-Dee and Garry, viz. the ridge from Cairngorm to Beinn Udlamain, now breached by Glen Feshie, Loch an t'Seilich and the Pass of Drumochter, but pre-glacially unbroken.

once united in a normal fashion to form the convergent headwaters of a tributary of the Dee. Barrow, with probably more intimate knowledge of the ground, added a very significant contribution, pointing out that if one climbs steep walls of the Tilt valley, the gorge section of Gleann Mòr, or of the Tarf beside its falls, one emerges in each case to " open and comparatively flat ground," and that the direction of these gently sloping surfaces is toward Aberdeenshire. " Starting," he wrote,[7] " from the broad open part of the Tarf valley and proceeding toward the Tilt, the Tarf enters a gorge, shallow at first but increasing in depth as its downward course is followed. But the old flat does not disappear ; it still continues above the lip of the gorge till the lip of the Tilt gorge (*sic*) is reached, when the old flat is seen to belong to the old drainage system of the Dee." He indicated further that at this stage the water-parting between the Dee and Garry catchments crossed the line of the present Glen Tilt " about half a mile above the Forest Lodge, where its position above the lip of the gorge is indicated by the contours close to the little stream. These contours are almost at right angles to the Tilt and the steep slope indicated by them faces up the valley " (i.e. to the Dee).

Later work has served only to confirm these views. In 1944 Bremner pointed out that all the present tributaries of the Tilt above Dal-an-eas bridge (half a mile above the Forest Lodge) coming in from its south side flow almost due north and make upstream junctions with the main river. On the opposite side of the latter two feeders enter (Allt na Maraig and Allt a' Chrochaidh) which begin by flowing parallel to the Tilt (north-eastwards down the old, gently-sloping surface noted by Barrow) but turn abruptly to fall over the steep wall of the present glen to the river more than a thousand feet below. Bremner rightly concluded that they had once been portions of a single stream falling north-eastward toward the site of the Falls of Tarf and the Dee and since disrupted by the torrents that gash the western wall of Glen Tilt. Its course is suggested by the broken line in Fig. 1.

We may thus conclude that an original consequent Tarf flowing eastward from an initial watershed in Gaick Forest was captured by a strike stream which grew out from the Dee along the Glen Tilt fault zone before the present erosion cycle began. During the greater part of this cycle the drainage has continued to follow this course and a subdued landscape was developed with open, mature valleys leading gently northward or north-eastward toward the Dee from a main watershed along the line joining Beinn Dearg and Beinn a' Ghlo. A good impression of this old landscape can still be obtained by looking southward from a viewpoint at the 1750-foot level just north of the Falls of Tarf and is reproduced photographically in Plate 1. The modern incision of the Tarf is conspicuous in the middle ground and the crags of Craig Dearg where it overlooks the confluence of An Lochain with Glen Tilt are seen on the left. But beyond the Tarf the ground appears to rise, as in fact it once did, in an unbroken sweep to the peaks of Beinn a' Ghlo on the skyline. Even on the ground it takes a most discerning eye to locate the present Glen Tilt although

the latter is here more than 500 feet deep. Here we may return to the point with which we began. The drainage of all the ground seen in this view and much more besides, amounting in all to some 44 square miles of country, has been transferred from the catchment of the Dee to that of the Tay during the present cycle and now passes by way of Glen Tilt through what was formerly the main Grampian watershed. And this change has occurred recently enough for the Falls of Tarf to remain as a witness to the disharmony which it produced in the levels of main stream and tributary. The diversion of the Tarf was only a part, though the most considerable part, of the change thus wrought, and it constitutes, as we now see, the second or southward diversion of that river.

The Southward Diversion of the Tarf

To effect this diversion the watershed was shifted some five miles northward from its former position above Forest Lodge : to carry the watershed to its present position the required shift is seven miles. These changes were ascribed by Bremner in 1912 to the unaided operation of the normal processes of river development. He believed that we have here a true river capture, that a subsequent outgrowth of the Mhairc tributary of the Garry, supposedly aided by a steep fall to the latter river and most certainly by the real advantages offered by the Tilt shatter belt, gnawed its way back through the high Beinn a' Ghlo watershed to capture the drainage of the territory beyond. In 1919 he wrote: " The conviction that this is one of the clearest, most typical, and most impressive—certainly the most impressive in the British Isles—cases of river capture hitherto recorded has grown stronger during the twenty years that have elapsed since I first studied it." This is a strong, if clumsily expressed, conviction, but it is one which the present writer does not share. River capture in such circumstances is inherently much less probable than Bremner apparently imagined, and a hypothesis based on river capture is quite unable to account satisfactorily for all the features observed in the field, or even all that have been ascribed to it. The full story of Glen Tilt is complex and no pretence is made here that all its complexities are unravelled in the present account. The latter is offered as the simplest hypothesis consistent with the field evidence collected in 1940, 1948 and 1949.

The consideration that makes Bremner's hypothesis of diversion by normal river capture highly improbable is simply this. Capture of the original consequent Tarf by one or other of the two subsequents developed along the Tilt fault-zone (which Bremner has usefully called *Tilt S* developed from the Garry and *Tilt N* developed from the Dee [8]) was inherent in the original disposition of streams and structures and can be regarded as having been inevitable. Either subsequent offered great advantages with which the now-vanished consequent trunk could not compete. But what advantages *Tilt S* possessed that would enable it to steal the proceeds of piracy from the initially more successful pirate *Tilt N* are not obvious. Both streams were operating in the same zone of favourable geological structures and any advantage *Tilt S* may have had in working to a lower local base-level at the

Garry confluence would be severely offset by its woeful lack of volume. The advantage of *Tilt S* over *Tilt N*, if indeed it ever possessed one, could have been, at best, only what mathematicians call a quantity of the second order, and such differences, in terms of process, do not lead to results which, in the statement just quoted, can be called " certainly the most impressive in the British Isles."

This leads to our second consideration—the correspondence between the expectable consequences of river capture and the field evidence. So small an advantage as that which may be presumed between *Tilt S* and *Tilt N* could make itself felt only over a long period of time. By the time the divide had migrated five miles along a strike vale it is to be expected that the vale itself would be substantially degraded throughout its length and that tributary streams would have had ample time to adjust themselves to the changed conditions. Reality could not be more different. We have already seen that portions of the old *Tilt N* valley system remain visibly perched a thousand feet or more above the modern floor of Glen Tilt, and that even so large a stream as the Tarf water has done practically nothing to remove an inequality of two hundred feet. The extension of the *Tilt S* catchment has all the appearance of having happened too suddenly and too recently for the streams involved to have adjusted themselves to the change. Bremner, it must in fairness be added, was clearly well aware of this lack of adjustment and its corollary, but did not perceive the discrepancy between the sudden and recent migration of a major divide by five miles and the hypothesis he advocated to produce it.

Finally, we must note that a hypothesis of normal river capture does not take into account and is unable to explain all the field evidence. In particular, it ignores the intimate relationship between the erosive work of ice and the present forms of the valleys. On a hypothesis of diversion by normal river capture the form of the opening through the former watershed should be that of a young water-cut valley ; the several tributaries should join the diverting stream through gorges of adjustment with nick-points at their upper ends, and the reversed portion of the former *Tilt N* should show a similar relation to its one-time valley floor. Two of the diverted streams—the Tarf and the Gleann Mòr burn—certainly do show such relationships, but equally they are not displayed by An Lochain or on the floor of the old *Tilt N* valley. As for the opening in the main watershed, Barrow regarded it, apparently in all good faith, as a water-cut gorge. There are parts of Glen Tilt to which this description can be applied, and to explain their supposed preservation from pre-glacial times Barrow supposed that the glen was " ice-logged," [9] i.e. filled with stagnant ice and thus excluded from the general pattern of ice-movement. Bremner took over this view and saw no reason to dissent from it even in his last paper.[10] But it is a manifest fact that the whole of Glen Tilt has suffered modification by ice (though not necessarily as the latest incident of valley history) and that some parts of it, and those the most vital from our present view-point, constitute a true glacial trough of majestic proportions, not significantly modified since it was shaped by

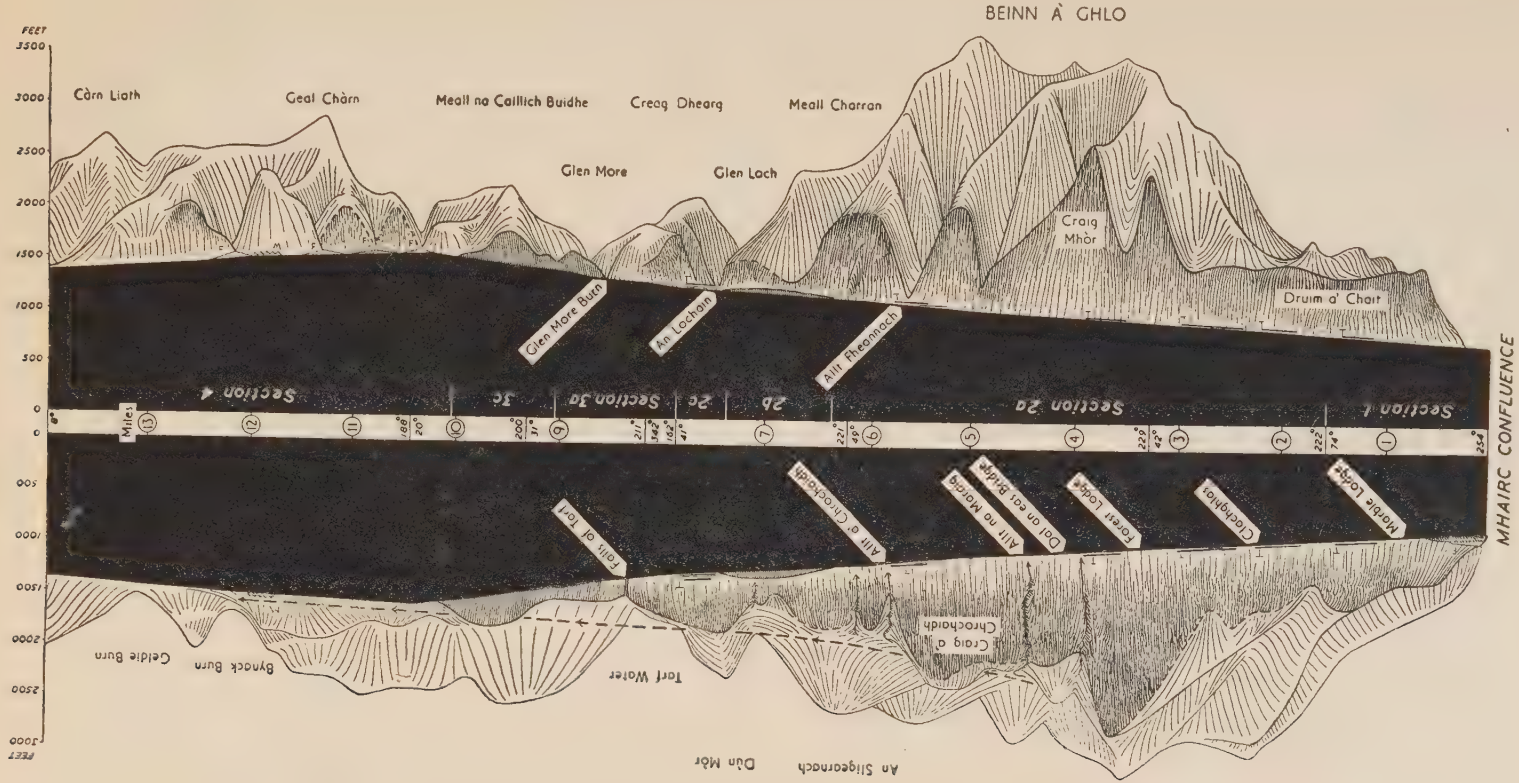

BEINN À GHLO
Càrn Liath
Geal Chàrn
Meall na Caillich Buidhe
Creag Dhearg
Meall Charran
Glen More
Glen Loch
Craig Mhòr
Druim a' Chait
Glen More Butch
An Lochain
Allt Fheannach
Section 4
3c
Section 3a
2c
2b
Section 2a
Section 1
Miles
FEET
3500
3000
2500
2000
1500
1000
500
0
Allt a' Chrochaidh
Allt na Maiche
Dell on east bridge
Forest Lodge
Cleeghlas
Marble Lodge
Craig a' Chrochaidh
Tarf Water
Byrack Burn
Celtie Burn
An Sligearnach
Dun Mor
MHAIRC CONFLUENCE

Fig. 1.

the ice. This apparent blindness to part of the evidence on the part of these two highly acute observers is surprising, particularly so in Bremner's case, since he correctly diagnosed, as we shall see, the true character of Glen Loch. But the fact that such misreading of the evidence has been possible makes it necessary to supply here some description, section by section, of the diverse parts of this long, composite, through-valley.

The Subdivisions of the Tilt Through-Valley

The *Tilt S* has been spoken of as an outgrowth of the Mhairc. Accordingly our description begins at the Mhairc confluence where we leave the lower Tilt, which continues the southward direction of Gleann Mhairc, and enter the north-eastwardly directed through-valley. The distances marked in miles on Fig. 1 are measured from this point. This diagram has been prepared by projecting the heights of the bordering hills and valley walls as shown on the one-inch map from each side on to a composite line made up of straight lengths following the centre of the valley. The true bearings of these segments are indicated. The vertical exaggeration is 5·28 times, in order to reveal the varying gradient of the valley floor. The description that follows is as far as possible transcribed from field notes.

Section 1. Below its confluence with the Mhairc and for a mile and a half above it Glen Tilt is glacially modified, but not conspicuously so. Drift plasters the steep walls, locally in great quantity and notably where it has been deeply ravined in the last two decades opposite Auchghoul. At least three fluvio-glacial terraces may be recognised, and the Mhairc fan, which is of large size, is conspicuously terraced, but the Tilt itself roars in a rock channel. Upwards, the steep walls rise to shoulders at about 1300 feet which give on to the smooth topography of the Atholl platform.

Section 2. Half a mile above Marble Lodge the valley is constricted by outwash terraces backed by moraine, but in passing these one emerges suddenly into a U-trough of classic form. There is at the same time a change of direction (from 254° to 222° true), so that the trough does not open directly down-valley : any view from further upstream is closed by the steep wall of Druim a' Chait. This wall was hollowed out to some extent to let ice pass down valley, but it was also overridden so that Tilt ice passed across into Glen Fender.

From this point the trough continues for just over six miles without significant change of form or direction. From any view-point clear of the minor irregularities of its floor the trough may be swept by the eye throughout its length.* Its walls are astonishingly rectilinear. Their lower slopes are mantled in drift and scree and rise at angles of 28° to 33°. The upper slopes steepen to 50° to 55° and, in the central portion, break into crags of exceedingly fresh aspect. The trough walls bear

* The whole six miles of this trough are well seen in the photograph taken from the lower slopes of Druim a' Chait which forms the frontispiece of the Geological Survey memoir to accompany Sheet 64. It might well be taken as a type specimen of glaciated valleys in general and was so used by C. C. Carter in an elementary textbook (*Land Forms and Life*, London, 1931, Plate III B).

no relation to the spurs they truncate except as regards altitude. They rise to higher levels in the first two miles, reaching heights of at least 2350 feet near Forest Lodge (where we have seen that Barrow and Bremner draw the old watershed (Fig. 1)), and decline slowly in the next two miles and more rapidly in the last two. The trough is thus shallowest and narrowest and least impressive near its upper end : it is grandest just above Forest Lodge where it is fully 1300 feet deep and about a mile across at its lip. This is the essential Glen Tilt and is an indubitably ice-moulded feature despite Barrow's inference to the contrary. Seen on the map it is as out of harmony with the drainage pattern as, seen on the ground, it is unrelated to the slopes above it. It shows, moreover, all the features we have mentioned as diagnostic of a glacially-breached divide. The present writer can therefore find no reason for not believing that ice, accumulated in the Tarf basin and debarred by the Cairngorm glaciers from its natural outlet by the Dee valley, overflowed the main Grampian watershed through a pre-existing notch, and poured into the basin of the *Tilt S* with such vigour that the divide was lowered roughly 1000 feet and displaced four miles upstream almost, but not quite, to the present Falls of Tarf. This six-mile trough, in a word, was *created* by the ice (though pre-existing fault-guided segments of the valleys of *Tilt S* and *Tilt N* determined the direction and eased the labour), and it is this violent act which is to be invoked to explain the discordances of the present rivers.

When we descend, however, from the view-point which permitted us to see and think of the trough as a whole to the trough floor we find considerable irregularity of detail. To describe this we may sub-divide the trough into sections *a*, *b*, and *c*.

Section 2a. This comprises three-quarters of its whole length and is of U-form throughout. Behind the moraine which marks the lower limit of the section there is a flat floor of fluvio-glacial material in which the Tilt is incised by an amount which increases upstream to more than 20 feet near Clachghlas. Half a mile below Forest Lodge the Tilt has wandered to the western side of the trough floor and there become superimposed from the gravel fill on to a rock spur into which it has cut a matter of 25 feet. It appears that a course only a few yards to the east would have been wholly in gravel. Above Forest Lodge is a morainic blockage with terraced gravel beyond, and further terraces lead to a 50-foot rise in the valley floor at the Allt Fheannach confluence. The fans from the tributary gullies, Allt Fheannach and Allt a' Chrochaidh and others, now begin to encroach on the trough floor and to simulate a V-form. None of these incidents, however, disguises the essential uniformity and grandeur of this part of the trough.

Section 2b. At about 6·3 miles from the Mhairc confluence a significant change occurs. Instead of flowing below banks of drift the Tilt occupies a channel cut in solid rock. As one goes upstream this rock-walled channel is seen to have the aspect of a spillway cut by glacial meltwater. Solid rock is also seen in the side gullies and on one or two no drift is seen within 80 feet of stream level. Opposite Meall Charran the cross-profile of the valley may be said to comprise three

distinct elements : (i) an open upper trough, roughly above the 1500-foot level ; this passes down by a broad convexity into (ii) rather steeper slopes which would intersect in a V above river level and show, in the lateral gullies, a skin of drift resting on rock ; (iii) the rock-walled channel. This section, which is really a water-cut defile below the main trough, extends for a mile. Just before the An Lochain confluence is reached the solid rock passes below stream level and the defile opens out into:

Section 2c. This section belongs as much to the glacial trough of An Lochain and Loch Loch as to Glen Tilt. It is quite short and ends only half a mile above the An Lochain confluence in a steep and craggy slope some 400-500 feet high. This craggy slope closes any view up the Glen Tilt trough and, to a lesser extent, up the Loch Loch trough also. We have in fact here come to the " trough's-end " in the technical sense of that term, i.e. the rock step at the upper end of a glacial trough, and this one fulfils this function in relation to both the ice-worn troughs just mentioned.

The Tilt does not tumble over this rock-step in a fall. It gets into the trough by a deeply incised gorge at its north-west corner and then runs for half a mile to the SSE in a swinging course incised some 40 or 50 feet into the rock. At its confluence with An Lochain and above the entrance to the defile *2b* it has spread out a good deal of gravel and then dissected it into a small flight of terraces (Plate 4). These are at heights approximately 23, 40, (45-48), and 90 feet above low-water level, the present flood plain (where such a feature can be recognised) being 6 feet above the same datum. These terraces are purely local features and it can hardly be doubted that they represent sections of valley floor graded to temporary base levels presented by the level of the rock sill in the defile *2b* just downstream. In part the stream was able to level its valley floor by laying down the coarse gravel of its traction load, but in part it cut its terraces in solid rock. On the east bank the 40-foot terrace has only a skin of gravel on schist.

Section 3. This is essentially a water-cut defile of V-shaped cross-profile throughout its two-mile course. For part of this distance (*3a*) the walls of the V rise to about 1500 feet and pass fairly smoothly into much gentler upland topography, the old floor of the *Tilt N* somewhat hollowed out here by ice into a shallow basin and plastered with drift. Below this V there is, in the first part of this section, a conspicuous rock-walled inner channel (like that in *2b*) whose depth varies from place to place but is about 30 to 40 feet near the Falls of Tarf. The latter empty precipitately into this V-in-V valley from a meagre notch cut in its western wall. The Gleann Mòr burn enters a little upstream by a very impressive rock gorge cut some 180 feet below the eastern wall. Above this confluence the V-in-V character of the valley is not obvious and there appears to be a single V cut below the glacially modified high-level topography. The last half-mile of this section (*3c*) is the most interesting. The water-cut V continues unchanged in form but grows deeper as its side walls rise to 1750 feet, 300 feet above the stream. Moreover, instead of passing into the older topography by a rounded convexity, the V here ends against the upper surfaces in an

abrupt break of slope marked by outcropping rock (Plate 6). The relations suggest strongly that the V has been quite recently cut in the hill mass. The map shows that this section of the Tilt's course is cut directly across the western spur of Meall na Caillich Buidhe by which that hill is joined to a rounded hill rising a little above 1750 feet a mile south of Loch Tilt. At the northern extremity of this defile a minor feature makes the matter even clearer : the V is cut entirely in ground falling continuously from west to east. There is a slope from the summit of the rounded 1750-foot hill to the western lip of the V ; the eastern lip is at a lower level and here the same slope picks up again and falls eastward a little further before passing under a flat expanse of peat. The V is without doubt an overflow channel cut by meltwater when ice still lay in the hollow where the peat now lies. For two or three hundred yards that ice formed the eastern wall of the spillway.

Section 4. At the northern end of this spillway there is a dramatic change in the whole character of the valley. From a view-point on the eastern rim of the spillway one looks north into a relatively wide and flat-floored trough which falls generally northward toward Bynack Lodge and the Dee (Plate 7). It lies partly along the line of the old *Tilt N*, but the ice which gouged out the broad floor and trimmed back the faces of the eastern hills to truncated spurs has left no traces of that preglacial valley. Barrow believed that the ice concerned came from the Cairngorms and was intruded southwards into the old *Tilt N* valley.[11] He regarded the abundant moraines that litter the valley south of Bynack Lodge as marking stages in the retreat of this ice, and from this view the present writer sees no reason to dissent. South of these moraines the lateral streams descending from the east have built a sequence of cones on to the trough floor. These have so far obstructed the northward drainage down the trough that, between the cones, peat accumulation is general. The southernmost of these cones has been built by the Allt an Ruidh Ghil. On it lies the watershed between the Dee and the Tay, the boundary between the shires of Perth and Aberdeen. The watershed is thus one of that numerous class known as *corrom* watersheds, a mere accident of gravel accumulation in the middle of a trough of slight and irregular gradient. In fact at some very recent date the water of the Allt an Ruidh Ghil spilt down the other side of its fan, for as noted by Bremner [12] there " can be traced a former stream track heading towards the Dee, so recent that, although excavated in incoherent gravel, it is still unobliterated. The fan," he says, " has switched off the Allt an Ruidh Ghil towards the Tay." But it could not have done so had the spillway *3c* not been open to receive it and lead its waters southwards as the Allt Garbh Buidhe to the Falls of Tarf, and had the trough of Glen Tilt not already been opened through the main Grampian watershed. To these events we must therefore turn, but before doing so it is necessary to notice the character of the through-valley of Loch Loch.

The Glen Loch Trough. From the confluence of An Lochain with the Tilt up to the lower end of Loch Loch is rather less than two miles ; in this distance the stream descends about 270 feet through an obviously glaciated valley. The walls are steepened and straightened, their

Plate 1. VIEW OF OLD MATURE UPLAND TOPOGRAPHY OF THE *TILT N* BASIN

Incision by Tarf gorge across the middle ground leads to Glen Tilt (left) ; the cliffs of the trough's end are seen a little to the right of the confluence ; in the centre background Glen Loch leads through the main pre-glacial watershed to Ben Vurich ; on the right the course of Glen Tilt is hardly discernible in the old topography leading up to the peaks of Beinn a' Ghlo.

Plate 2. FALLS OF TARF—UPPER FALL AND GORGE OF ADJUSTMENT

Plate 3. FALLS OF TARF—LOWER FALL AND POOL OF TARF

Plate 4. CONFLUENCE OF AN LOCHAIN (right) AND TILT
Showing terraces and closure of the trough upstream by the cliffs of the trough's end

Plate 5. LOCH LOCH LOOKING TOWARDS BEN VURICH AND THE MORAINIC WATERSHED WITH THE ISLA DRAINAGE
Note the crescentic retreat moraines across the loch

Plate 6. THE SPILLWAY THROUGH THE ALLT GARBH BUIDHE DEFILE
Looking southwards towards Beinn a' Ghlo

Plate 7. THE BYNACK TROUGH
Seen from a view-point a few yards from that of 6: the present Tilt-Dee watershed lies on the fan of the Allt an Ruidh Ghil which shows darkly on the floor of the trough

lower slopes are plastered with drift locally cut into terraces. High up on the eastern side of the trough an old topography is seen above 1800 feet below Creag Dhearg and in the perched valley of the Allt Feith Ghiubhsachain. The loch itself is about a mile long with a surface level of 1500 feet, and dammed at both ends by moraines. Two crescentic moraines cross the loch itself (Plate 5). The slopes beside the loch rise into steep cliffs of rusty weathering schist on the eastern side and on the western side the quartzite is strongly ice-scoured (" boiler-plated ") though partly mantled by scree and moraine. The watershed between the northward drainage to Glen Tilt and the southward flowing Glen Loch burn, whose waters ultimately reach the Tay by way of Strath Ardle and the River Isla, comes about three-quarters of a mile beyond the loch where a hill burn descending from the main peak of Beinn a' Ghlo is deflected northward by its own detrital cone—another corrom watershed. Immediately beyond, the Glen Loch burn heads in a marshy flat and threads its way through a belt of well-developed moraines which no doubt mark what was for a relatively long time the position of the margin of the ice-tongue protruded through Glen Loch from the country to the north and west. Above the moraines on the eastern side of the valley there is ample evidence in moutonnée surfaces and plucked crags that ice movement was to the south-east.

This through-valley—which we may conveniently refer to as Glen Loch—permitted ice to pass from one side of the main Grampian watershed to the other at a level many hundreds of feet below any of the cols to the east. All the features of a breached watershed are present—the streamlined trough, the fresh crags rising to their greatest eminence at the site of the former watershed, the long loch in the trough at the summit of the pass where ice movement was most constricted and most swift, the perched topography above the trough shoulders, the rejuvenation of the " be-trunked " streams like Allt Feith Ghiubhsachain, and the strong contrast with the little-modified valleys which adjoin on the east. The Gleann Mòr and Glen Lochsie burns, and Allt Feith Ghiubhsachain and Allt Fearnach, form pairs of streams heading on opposite sides of the watershed and flowing in opposite directions away from cols which are now at 2550 and 2130 feet. The latter appears to have suffered a little erosion, but ignoring this these cols afford some picture of the pre-glacial condition of the col on the site of Loch Loch, and their altitudes, which must have been greater than that of the col where the breach was actually made, allow us to estimate that to have been about 2000 to 2100 feet. Not less than 500 feet of schist and quartzite were removed here by the ice.

It is noteworthy that in his last paper Bremner had recognised this.[13] " In the lee of the Beinn a' Ghlo group," he wrote, " and between it and Carn an Righ, a great ice-stream from the Feshie and Tarf basins poured S and SE to unite with that coming from the W. This northern ice . . . flowed up An Lochain and ground out the great hollow containing Loch Loch, lowering by many hundreds of feet the An Lochain-Glen Loch burn watershed." In his mind, however, the phenomenon was clearly the special result of special circumstances.

It did not occur to him that here was a key that could unlock other doors, and could in particular be used to turn the lock that prevented access to the secrets of Glen Tilt. In the next paragraph he affirmed again that, south of the An Lochain confluence, Glen Tilt " was filled by ice from the west that, finding its eastward path blocked, became practically stagnant and incapable of any appreciable amount of erosion."

The Sequence of Events

If this summary of the morphological evidence has been adequate it will be seen to lead to the conclusion that three separate sets of circumstances have been involved in the diversion of the Tarf and the attendant migration of the watershed to its present position. They are:

(*a*) the glacial erosion that produced the Glen Tilt and Glen Loch breaches in the pre-glacial watershed ;

(*b*) the local circumstances that led the Tarf and the Gleann Mor Burn to fall into the Tilt trough when it was free of ice ; and

(*c*) the overflow of meltwater impounded by Cairngorm ice to cut the Allt Garbh Buidhe spillway.

Glacial erosion shifted the watershed four and a half miles from Forest Lodge to the trough's-end which forms the common upstream termination of both the Glen Tilt and Glen Loch troughs. Had the Ice Age continued longer there is no doubt that this rock-step would have retreated further upstream to and beyond the site of the Falls of Tarf. Had it it ended earlier each trough might have had to this day its own trough's-end. The present position of the rock-step is thus a sort of historical accident. Below the step the ice-stream must have split in two, and the question is raised what was the relation between these two breaches in the main Grampian watershed. In considering this point two things become clear. First, that Glen Tilt was the earlier breach of the two. It opens south-west, almost in the teeth of the western ice, while Glen Loch leads south-eastward into Strath Ardle and is likely to have been a much more efficient outlet. If a new glaciation should supervene to-morrow it is clear that most of the ice would use Glen Loch. From this the second point follows. If the watershed was first breached along the line of Glen Tilt that can only have been because the col here was significantly the lowest in the divide. But we have already argued that the pre-glacial col on the site of Loch Loch was about 2000-2100 feet above sea level. How much lower the Tilt col would need to be to show the advantage it undoubtedly had is a matter of opinion. If we say 200-300 feet, we are led to assume an altitude of about 1800 feet for the Tilt col, and, since the ground on either side rises to over 3000 feet, to picture the pre-glacial pass between *Tilt S* and *Tilt N* as a deep, relatively narrow, and very decided notch in the Grampian watershed. A rough computation suggests that about two-thirds of a cubic mile of rock were removed to breach the Tilt col and erode the Tilt trough, and a comparable amount in the case of Glen Loch. These are large amounts but not fantastically or incredibly so. Moreover, it is not necessary to assume that all the work was done

in the last glaciation : earlier glacial and interglacial erosion may have played a considerable part. As has already been hinted, another glaciation might carry the process still further and produce a streamlined trough all the way to Bynack and the Dee.

As it was, when the ice of the last glaciation was melting and uncovering the landscape, the trough's end was still short of the Tarf by a third of a mile. But the old valley-floors of the Tarf and *Tilt N* above the rock-step had not survived the glacial episode unmodified. The contours of the relatively gentle drift-covered hill slopes on all sides of the Falls of Tarf suggest that a shallow and irregular hollow had been excavated down to the 1500-foot level around the former Tarf-*Tilt N* confluence. Escape from this depression along the line of the old *Tilt N* valley, marked roughly by the peat-floored col at 1650 feet leading to Loch Tilt, was probably debarred by stagnant or northern ice. Overflow occurred at the earliest opportunity in the only other direction available, into the Tilt trough. Initially there must have been a cascade down the rock step. In the trough itself the stream found an irregular rock floor. Where the ice-stream had divided it had lost eroding power and both troughs therefore possessed reversed gradients. That of Glen Loch persists right up to the loch and beyond and the new drainage flowed northward. The reversed gradient in Glen Tilt, however, persists for only half a mile and, after aggrading the trough behind it, the new drainage overflowed the barrier and cut the defile of section 2*b* and the gravel and rock terraces of Section 2*c*.

Gorges of adjustment no doubt began to work their way up the Tarf and the Gleann Mòr burn. Bremner was much exercised by the fact that the former (to the 1500-foot contour) is only 0·45 mile and the latter (to the same contour) 1·7 miles long.[14] To explain the discrepancy he adopted an ingenious hypothesis of successive captures, that of the Tarf being delayed by the more northerly position of its former course. Unless the whole submission made in the present paper is founded in error this view is untenable. There was neither capture nor any surviving high level river to be captured at the moment when these gorges were initiated. The present writer is prepared to believe that the explanation of the discrepancy lies in the very factor which Bremner rejected—namely, differences in rock hardness. The Tarf on the western side of the Glen Tilt fault is operating in tough massive Moine schist (Plates 2, 3) : the Gleann Mòr burn, across the fault, is to a considerable degree advantaged by limestone and black schist. Moreover we do not know what the relative discharges of meltwater down these two channels may have been. Nevertheless the cutting of a gorge 180 feet deep at its mouth and extending back more than a mile in generally tough rocks is a very considerable achievement for local post-glacial time.

Finally, there is the extension of the Tilt drainage to the present county boundary brought about by the overflow of meltwater from northern ice through the defile of Allt Garbh Buidhe. There appears to be some warrant for thinking that this was a separate episode occurring some time after the other events that have been described and possibly to be related to a re-advance of ice from the Cairngorms into

the Bynack area. At the Tarf and Gleann Mòr confluences the water-cut defile, it will be recalled, shows two stages. The little gully which gashes the rock wall of the upper V opposite the Falls of Tarf has spread out on the floor of this V, which is locally ample enough to form a rude terrace above the later rock-walled channel, a detrital fan. Presumably the upper V was opened up by the Tarf and Gleann Mòr burn and the sides of the V gullied and fans and other gravels spread out on the roughly-graded floor before the new phase of incision occurred. This phase is definitely to be identified with the cutting of the spillway : the inner V when traced upstream from the Gleann Mòr burn confluence becomes the whole V. Downstream also it is attractive to see traces of this same access of volume and vigour in the final downcutting below the 23-foot terrace at the Glen Loch diffluence ; in the inner rock-walled cut below the V in Section 2*b* ; and in the dissection of the outwash gravels and local incision in rock in the main trough 2*a*.

The history of the southward diversion of the Tarf is thus seen to be much more complex than the older workers had supposed. The process which they invoked to explain it—the headward enlargement of a subsequent stream along a belt of weak rock structures—appears to the present writer quite incapable of explaining the great variety of features which are in one way or another associated with the diversion, and finds no place whatever in the explanation here offered. That explanation is hardly likely to be the whole story, but there is little doubt that in the fullness of time the whole story will be elucidated. For Bremner was certainly right when he characterised the diversion as among the most impressive in the country, and later workers will not rest content while any part of so interesting a story remains obscure.

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N.B.—In Fig. 1 Gleann Mòr has been called " Glen More."

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[8] Bremner, A. *op. cit.*, 1944, p. 93.

[9] Barrow, G. *op. cit.*, p. 105.

[10] Bremner, A. *op. cit.*, 1944, p. 95.

[11] Barrow, G. *op. cit.*, pp. 106-107.

[12] Bremner, A. *op. cit.*, 1912, p. 17.

[13] Bremner, A. *op. cit.*, 1944, p. 95.

[14] *Ibid.*, p. 94.

THE DANISH HEATH SOCIETY

By Erik Schacke

There is no doubt that Denmark in very olden times was a wooded country and that about A.D. 1000 very large parts of Denmark were still covered with pathless forests. As elsewhere they were recklessly cut : how else can we account for the great shipbuilding of the Vikings ? Fires, many wars through the ages, and neglect completed the destruction. It was especially Jutland which was devastated of trees, to such an extent that about A.D. 1800 two thousand two hundred square miles consisted of heath and moors, which as a barren almost continuous plain stretched over the middle and west of the peninsula. There were another thirteen hundred square miles of waste land in the rest of the country. The total amounted to more than one-fifth of the area of Denmark.

Efforts were made in the eighteenth century to cultivate the heath, but with very minimal success. One great hindrance was the scarcity of roads. Even in 1836 there were in the whole of Jutland only twenty English miles of what could be classed as proper roads.

It was, therefore, most fortunate that the Danish State in 1854 sent E. M. Dalgas, Lieutenant in the Engineers Corps of the army, to Viborg to survey roads. He took the greatest interest in his work and combined energy and conscientiousness with diplomacy and patriotism. As his work succeeded beyond all expectations and extended in many directions, it may be of interest to tell something of this man, who became one of Denmark's great sons. The forefathers of Enrico Mylius Dalgas lived near the Spanish border in France until his great-great-grandfather fled to Switzerland at the time of the religious persecution under Louis XIV, in 1685. His grandfather came to Jutland in 1783 to be clergyman in the town of Fredericia, and had amongst his parishioners some German settlers, brought in, on the Danish King's instigation, to cultivate the heath. King Frederik IV had interested himself in the cultivation of the barren land and caused some German families to come to Denmark in 1720. By the end of the eighteenth century, the members had increased to 550. The minister visited their poor homes on the heath and helped them with advice ; he himself took great interest in the open-air life and experimented with plants which would grow on his land and on that of the settlers. Two sons left Denmark, going first to England and then to Italy, where the elder settled in Livorno, the other in Naples in 1813.

Here Enrico Mylius Dalgas was born on 16th July 1828, but his parents—his mother was also Danish—moved the following year to Venice and later to Livorno, where he went to school. His father died in 1835 and his mother, with Enrico, returned to Denmark. It was a great struggle for the mother to make ends meet, but the uncle and Enrico's godfather, Mylius, helped with annual contributions. Enrico attended school for the following ten years. His headmaster called him " heavy, but of exceptional energy and industry." The uncle wanted him to join his firm in Livorno, but Enrico's ambition was to become an officer in the Danish Army. In 1848 the Germans

in Holstein rebelled and a three-years' war developed in which the rebels were greatly supported by Prussians and other Germans. Enrico Dalgas was on the outbreak of war appointed lecturer for recruits for the artillery, but saw active service in 1849-1850. He lost two brothers in the war, which ended victoriously for Denmark. Enrico Dalgas's godfather, Mylius, in Italy was German born and had demanded that he should leave the army, but Dalgas's firm character and patriotism showed itself and he would rather forgo a considerable inheritance than fail in his duties. The godfather duly struck Dalgas's name out of his will, but, while naturally disappointed, Dalgas bore him no malice.

After the war Dalgas married and, as already mentioned, started road surveying round Viborg in 1854 as first Lieutenant, was the following year promoted to Director of the work, and gained his Captaincy in 1856. Although he later became Colonel, it was as 'The Captain' that he remained known amongst the farmers and dwellers of the heath. The practical Dalgas, full of energy and enterprise, felt the need to further the work which had been begun on a small scale. In 1865 he wrote an article in the leading paper pointing out that, though 40,000 acres had been cultivated during the last twenty years, there were still about two million acres lying waste, and he advocated that the State should assist by offering trees for planting free of charge. At last, along with his friends Drewsen Morville and Mourier-Petersen, Dalgas succeeded on 28th March 1866 in forming Det Danske Hedeselskab, the Danish Heath Society.

The purpose of the Society was "in every manner possible to improve the fertility of the Danish heath," and it was made a major part of the programme to interest the local inhabitants in the cause and to induce them to take an active part in the Society. It was to be a national one for the people, supported by the people, headed by the King as Patron, and the Society has awakened interest for its work to such an extent that wealthy men in Copenhagen and other towns have bought stretches of heath and spent large sums on their cultivation and planting, not with any financial gain in view, but purely from an altruistic motive.

The aims of the Society were classified as follows : (1) Planting on moors and other ground not suitable for anything else. (2) Planting for shelter and fences. (3) Drainage and irrigation. (4) Cultivation of bogs, marshy meadows and similar ground. (5) Working bogs industrially. (6) Supplying lime and marl to districts badly in want of it. (7) Any other work in connection with land development—originally for North Jutland only, later extended to any part of Denmark.

These aims were to be reached by means of publication of a magazine ; lectures, discussions and research, planning and guidance of work required ; starting and working the Society's own plantations and bogs, to serve as models for the public ; establishing and maintaining its own plant nurseries as well as supervising private nurseries, to enable the public to obtain trees for planting at reasonable prices ; obtaining financial support from the State, County Councils, institu-

tions and private individuals. The subscription was put very low : 5s minimum yearly or £5 for life members.

The Society is directed by a Committee of forty-four members and a council of nine, the Ministry of Agriculture electing three of the council members. It has departments for marl ; research for improvement of the land ; bogs and marshes ; regulations of waterways, artificial drainage and construction of dams ; planting.

Colonel Dalgas quickly won the confidence of the population in the heath districts by extensive irrigation works, by constructing better roads and by providing marl. As conditions gradually improved, the population of the heath districts became willing to participate ; plantations were begun and hedges planted. The Heath Society managed this pioneering work by private initiative because of the confidence it inspired from the beginning, and thus led to its recognition as being of national importance.

Marl

Realising that the use of marl was indispensable to cultivation, Dalgas undertook a thoroughgoing search for marl, and, when found, it was dug out by fork and shovel, pushed in wheelbarrows, carted long distances along sandy heath tracks in carts drawn by oxen until special rail tracks were laid, but these proved very expensive. Then the use of movable tracks was started in 1904, laid over fields, and the marl deposited on the lands of the receiver. When one district was finished, the track was moved elsewhere. Nowadays excavators and motor lorries are used. Six thousand quarries of marl have been examined and of these two thousand have been worked. The Heath Society assisted in the foundation of societies to quarry marl : 69 such societies in 1949 distributed 30 million cubic feet.

Soil Research

In the period from 1915-40, 1½ million acres, or about 19 per cent. of Denmark's agricultural land, have been examined for requirements of lime and conditions of moisture. It was found that in Jutland two-thirds of the area examined required lime, on the islands one-third ; further, that one-quarter was found to be cold or wet soil. The findings resulted in extensive marling and draining. Since 1925 this research work has been extended to include mapping the individual properties for requirements of lime after a sample of soil from every acre had been examined, and a complete survey of the condition of the soil was thus obtained. These maps were not only drawn from results obtained in the laboratory, but also from recording the kinds of weeds growing on different soils. In 1939, the year before the war, 3300 properties with an area of 85,000 acres were examined for lime requirements. From 1925-40 altogether 18,879 properties of nearly 650,000 acres were examined, of which 57 per cent. were found deficient in lime. During the war little could be done in this respect, but in 1949, for instance, 1807 properties of 44,000 acres were examined. It is the general

impression in this country that Denmark is endowed by nature with soil suitable for agriculture, but these figures show that it is only through a co-operation of science, skill and hard work that Denmark can to-day produce large quantities of agricultural produce.

The soil in Denmark is of very heterogeneous quality, varying from decidedly sandy soil to heavy clay, and the virgin soils are mostly poor in plant nutrients, and the surface is sometimes rather undulating. Cattle must, on account of the climate, be kept in byres during seven months of the year, generally from the beginning of October to the end of April.

Research work by the Heath Society is also being done in different manures for forest plants and newly cultivated moorland. The laboratory carried out no less than 72,627 analyses in 1949.

Since 1937 borings to a depth of 2 ft. 8 in. have been made to determine whether the areas can best be cultivated for agriculture, or planted with trees, or left alone as heath.

Cultivation of Moors and Marshy Meadows

Moors and marshy meadows are spread over the country, mostly as relatively small areas lying between arable or heath land or along rivers and fjords. They form part of a very large number of landed properties. Dalgas was greatly interested in the cultivation of these, and, thanks to the work of the Heath Society, the Government, and the Agricultural Societies, half of the Danish moors and meadows have been brought under proper cultivation. It has been proved that the greater part of the crops of grass and hay required can be produced on moors, meadows and bogland, provided they are exploited rationally, thereby making possible a more intensive and lucrative utilisation of the arable land.

The Heath Society cultivated large areas of bog and meadow, irrigated the country round the Jutland rivers, dyked areas exposed to inundation, drained vast areas of flooded land and organised systematic spreading of marl containing 20-60 per cent. of lime over newly cultivated soil and thousands of acres of ancient farm-land which had become starved of lime.

The Society reports that in 1949 it has been occupied with 13,800 different schemes in connection with soil improvement and reclamation, affecting over 300,000 acres, at a cost of £7½ million. Of these, 5700 schemes, affecting 85,000 acres, were completed at a cost of £1½ million. The most important schemes completed are :

Regulation of water-courses affecting	16,212 acres.
Artificial draining	3,867 ,,
Drain pipe lines	700 ,,
Draining	3,500 ,,
Dykes	4,000 ,,
Artificial irrigation	100 ,,
Sundry schemes	1,850 ,,

Since 1919 the Heath Society has undertaken a most thorough

investigation of the Danish moors to ascertain which are suitable for cultivation and which for peat production. The most rational utilisation is first to use the chief part of the turf as fuel and afterwards to cultivate. On the basis of this investigation, which extended even to small bogs of 10 acres, the bogs were divided into four classes :

1. Bogs which, on account of a great content of ash or for other reasons, ought not to be worked for peat production.
2. Bogs where the depth of usable peat is less than 3 feet. Such are only of interest to the local population.
3. Bogs which can be used for the production of peat on a large scale.
4. Bogs where the peat is of such light quality that it cannot be used with advantage for the production of fuel peat.

This research was concluded in 1940 with the following result :

CLASS OF BOG	JUTLAND acres	ISLANDS acres	DENMARK million tons raw peat (25% water content)
1	110,750	19,500	83
2	85,250	20,750	73
3	52,500	15,750	53
4	22,750	72	32
	271,250	56,072	241
Percentage of area	4·9	2·1	4

The Society is planning a further investigation of all bogs—that is, including those smaller than 10 acres.

The work done in the department for Bog and Meadow is most impressive :

1945	4,227	schemes	affecting	45,292	acres,	cost :	£735,000
1946	5,106	,,	,,	48,872	,,	,,	945,000
1947	4,482	,,	,,	48,482	,,	,,	850,000
1948	6,125	,,	,,	67,475	,,	,,	1,370,000
1949	5,439	,,	,,	55,223	,,	,,	1,140,000
Total	25,379	,,	,,	265,344	,,	,,	£5,040,000

In addition to this there were thousands of additional schemes in hand, but not completed.

Since 1915 the Heath Society has taken up hydrometrical observation, which is now an important work carried out at seventy stations in Denmark. In order to plan drainage work it is necessary to know the rainfall, the condition of the streams, and to what extent the water seeps through the soil. The figures, of course, vary considerably in the different districts. One result is that it has been proved that 50 per cent. of the rainfall—and not, as previously supposed, one-third—is carried away in streams.

Denmark's moors covered, in 1866, 2,400,000 acres, or practically the area of the Danish islands. In 1896, thirty years after the foundation of the Heath Society, they had been reduced to exactly half, or 1,200,000 acres; in 1929 to 820,000 acres and in 1940 to 500,000 acres.

The Danish nation is entitled to be proud of its achievement in reducing the once endless heath and moors by about two million acres. It could not have succeeded if there had not been behind it the will to conquer—the will of thousands of brave, hard-working, thrifty men and women to take up the fight against the elements and nature. Public-spirited men and the nation as a whole gave great financial support, but it would have been of no avail if there had not been the right kind of people to do the work. The 'heath farmer' in the thousands of homes spread over the Jutland heath lives an active and frugal life. Work is considered a blessing, and a healthy human stock is reared.

The Heath Cultivation Society. The Heath Society provided the fundamental conditions for converting heath land into arable land by road making, marling, irrigation and afforestation. To help farmers, a subsidiary of the Society, the Heath Cultivation Society, was formed in 1906 to give economic support and expert advice to cultivators. During the first thirty years this Society granted subsidies, amounting to £145,000, helping 3753 smallholders to cultivate 185,400 acres. It is a matter of course that during the last century the work was much harder than it is to-day with the modern implements, the deep tractor plough and the knife harrow, which break up the hard pan, and the liberal use of marl and manure. The pan could hardly be broken by a simple plough drawn by oxen or horses. The Society now uses a plough specially designed to plough about 2½ feet deep and double breadth. It means that it now only takes one year after the heath is broken before seeds can be sown, where before it took five years.

After the interruption of cultivation of the heath owing to the Second World War, work has now been intensively resumed. Through the Society, the State gave grants in 1949 for the cultivation of 8750 acres. If the work continues at this rate—which it surely will—the Heath Society hopes to complete the cultivation of the heath in the course of another generation. Already now some districts are being preserved and are to be left for the future in their natural state.

Here in Scotland we are worried by the emigration which has—and is still—taking place from the Highlands and Islands. The reclamation of land which took place in Denmark from 1866-1925 has meant an increase of the rural population on the islands of about 30 per cent., but in Jutland, where the areas reclaimed were much larger, of 100 per cent. Property tax in rural districts increased on the islands from 1904-1916 by about 40 per cent., in Jutland by 76 per cent.

The Heath Cultivation Society just mentioned had, in 1930, 6300 members. An investigation of 620 holdings showed that they paid £7825 in rates and taxes, while this land before cultivation only yielded £1250.

Regulation of Waterways and Drainage

Right from its formation the Heath Society started the construction of canals for irrigation in the heath districts, and the work went forward to such an extent that, by 1900, 110 canals of a total length of 255 miles with an irrigated area of nearly 20,000 acres were completed. Now it is drainage which specially claims attention. The work consists of regulating the rivers and burns, lowering of water-levels, laying drain pipes and constructing dams. One such drainage undertaking benefited the surrounding area of 8000 acres at a cost of £25,000, or, roughly, £3 an acre.

In 1933 the State by statute offered to private individuals loans and grants on certain conditions for the improvement of the land. As a result, in the following seven years, with the assistance of the Heath Society, 32,200 different schemes, principally drainage, were executed, costing about five million pounds, the total area affected being over one million acres. The great number of individual schemes shows that the Heath Society does not only foster large enterprises but an immense number of small ones. Regulating water-courses entails the lowering of the water-level in districts suffering from an excess of water, by deepening the river bed and strengthening it, giving it a cross profile large enough to enable the water to run off, removing any obstacles to the free movement of the water, and rebuilding bridges for roads and railways. Nowadays the work is done mostly by mechanical means, but in years gone by it was hard manual labour and the lowering of water-levels by water screws driven by wind motors.

In 1949 the Heath Society completed drainage affecting 55,000 acres at a cost of £1¼ million. The Society has superintended works of draining by pipes covering more than 160,000 acres. In one year alone 26 million drain pipes were used. Producing the drain pipes afforded 200,000 days of work, and the drainage work another 400,000. One estate factor reckons that his yield had increased by 300 per cent. The Heath Society has supervised the building of dykes, reclaiming 23,500 acres of land from the sea.

A special undertaking for which the Heath Society designed the plans was a dam from the west coast of Slesvig to the island of Römö, which was to cost £375,000, and which was not only to serve as a road to the island but also to increase very considerably the collection of silt and thus create new marshland.

Afforestation and Hedges for Shelter

Dalgas realised that freeing fields from injurious water, and marling, would be useless unless the fields were given some shelter against the prevailing westerly gales which carried soil and seed far away. Only after shelter-belts had been planted could the farmer, so to speak, keep his soil at home. The Heath Society, therefore, founded—in close co-operation with the people—local independent planting societies to assist with advice and the actual planting of trees on farms. They distribute annually ten million trees at greatly reduced prices,

the State contributing about 50 per cent. of the cost price. The societies gather the members to lectures and show films and prove that proper shelters reduce the force of the gale by 40-50 per cent. and the trees affect twelve times their height. A hedge of thorn or *Sorbus intermedia* is preferable, but *Picea glauca* (white spruce), planted in a single row, is also all right provided it is well looked after and kept dense near the ground. Investigations have proved the advisability of collective planting over large areas reinforced by large and small plantations or forests. It stands to reason that forests offer a more far-reaching shelter than hedges and contribute to the reduction of the free wind speed. The climate, therefore, becomes less severe in a well-planted district than in an open one.

Jutland experienced in April 1938 a terrific sandstorm, as it had done nearly fifty years earlier, and those districts without proper shelter suffered enormous damage, estimated at £200,000. The State realised the importance of planting trees and paid both for the labour, thus helping unemployment, and half the cost of the trees. In return, the State demanded that local planting societies be formed where such did not already exist and that owners should clean and care for the plantings. By December 1940, 2500 miles of shelter-belts were planted with 4 million trees, and the following year 5300 miles with 14 million plants. In 1941 it cost the State in wages alone £800,000, or 1*s* 2*d* a tree.

During 1949, 14,800,000 conifers and 8,300,000 deciduous trees were delivered to about 19,000 receivers. Of these, 8,200,000 trees were planted by the society's so-called travelling corps, for the purpose of shelter. To-day conifers are common all over Denmark, but it is rather interesting that these trees did not originally grow in Denmark but have been introduced. The Norway spruce, which now occupies a quarter of the wooded area, did once grow in prehistoric times, but disappeared completely. It is only 200 years ago since this species along with silver fir, mountain pine, Scottish pine and larch was introduced. The conifers which gradually gained a footing were the mountain pine (*Pinus mugo*) and, as mentioned, the spruce fir (*Picea excelsa*). When it was proved that the mountain pine was an excellent pre-culture, especially for the Norway spruce, the plantations developed rapidly.

At the end of the eighteenth century the State bought and planted large areas, but it was only after the formation of the Heath Society, when private initiative and private capital stepped in and patriotic feelings were aroused through the ardour of Colonel Dalgas, that afforestation made headway. The result was that the wooded area in Jutland increased from 2·7 per cent. in 1860 to 9·1 per cent. in 1934. By 1949 nearly ½ million acres of conifers had been planted, of which the society has helped to start more than half in 3092 plantations. There is a saying, "A country without woods is often a poor one, but a country rich in woods a wealthy one."

In 1915, the Society supervised 2197 plantations covering 194,000 acres, and, in 1940, 2735 plantations totalling 225,000 acres. Previously the plantations were generally very large, but from 1915-1940

most of the plantations started were only 25-60 acres, planted by farmers on soil unsuitable for agriculture. Perhaps this is the ideal for the future, that each farm has its own little forest or plantation, which can supply the necessary fuel and various useful pieces of wood. Such plantations spread all over the country contribute along with the hedges to reduce storm damage and prevent or minimise sand and soil drifts and devastation of sown fields. Many farms have stretches of land which can more profitably be planted with trees than sown with seed. Plantations have helped the fuel situation during two long world wars and also given employment to many who might otherwise have been without work. The Society has distributed over 800 million trees for shelter. It means, if planted 18 inches apart, a distance of more than ten times round the world.

The Heath Society is also assisting with advice and inspection of the planting and plantations for game.

The Society initiated the formation of an insurance company for plantations. The entry fee is $2\frac{1}{2}d$ per acre, the annual premium less than one penny per acre. Plantations must be separated from moors by a belt of 50 feet free from plants and there must be fire breaks of 50 feet every 350 acres. The company pays a compensation in case of fire of £8 per acre for replanting.

The Society has assisted in the erection of saw-mills and has experimented with charcoal of value as cattle food, and tar which is quite remunerative; moreover, the Society has produced a fine quality of pine oil from the needles of the mountain pine. This oil forms the basis of the production of bath salts, soaps, balsams and similar cosmetic preparations. These are all manufactured by a private company, 'Danapin,' the Heath Society only producing the crude extract. The Society has also been instrumental in perfecting a semi-hard insulation board.

During the war, when Denmark was prevented from importing feeding stuffs, the Society sold, in 1940, 2000 tons, 764 tons in 1941, and in 1942, 336 tons fine heather. In the exceptionally dry summer of 1947, when the hay crop failed, 850 tons were sold, but it is only at exceptional times like these that heather for cattle food will be in demand. It must, of course, be free from wooden stems and cut from areas burnt off in recent years.

Peat Production

And last, but by no means least, we come to the production of peat. Cutting is only possible in May, June and July—June being the best month. The peat shrinks by drying to a quarter or a fifth. The ash content of peat in high bogs averages less than 5 per cent., in low bogs 8-9 per cent. Good commercial peat ought not to exceed 10-12 per cent. of ash. Sulphur content must not exceed 1 per cent. as the burning is otherwise injurious to fire-places and chimneys.

Before the war Denmark imported yearly 6 million tons of fuel, while the normal production of peat was 400,000 tons. In 1940, $2\frac{1}{2}$ million tons were produced by 6500 producers. The production

reached its peak in 1943 with an output of 6,100,000 tons—fifteen times more than in peace time, when 70,000 were employed. By 1947 the output had fallen 1 million tons with 46,000 employed. During the whole war about 40 million tons of peat were produced, of which twice as much came from Jutland as from the islands. It is reckoned that it takes $2\frac{3}{4}$ tons of peat to equal 1 ton of coal.

By 1949 the production had fallen to 1,400,000 tons and the number of employed to 8550 men, 2400 women and 1250 children under 18 years of age. Labour for agriculture is scarce and Denmark wants to keep some reserve of peat in the country in the case of wars in the future. Provided the country can obtain the necessary coal, therefore, it is not interested in working the bogs intensively for the sake of producing peat. It is very important that cultivation of areas where peat has been dug is started immediately, otherwise bushes and trees grow and make the work more expensive. One may also expect that calor gas to some extent will take the place of peat in country districts.

The many figures have been necessary in order to show to what enormous ramifications the Danish Heath Society has grown from such an insignificant start. In 1912, when Winston Churchill was First Sea Lord, and in that capacity inspected the first ocean-going motor-ship, invented and built by Danes in Copenhagen, he remarked, "Denmark, long foremost in agriculture, has now also taken the lead on the high seas." I maintain that Denmark, through E. M. Dalgas in 1866, took the lead in reclamation of moorlands through his formation of a philanthropic society; and why should Scotland not follow? Here is surely a cause for which the Fiery Cross should blaze. I have already before the war advocated the formation of such a society in Scotland, the aims of which will appeal to the patriotic Scottish nation. The Peat Development Committee has made a start, but it is too quiet and modest. The Danish Heath Society, an institution with private initiative, began in two small attic rooms in Colonel Dalgas's house, working in freedom for the common good in close collaboration with and extensively supported by the State, with such beneficial results. I am aware of the great work which is being done by the Department of Agriculture and the Forestry Commission, but I do think that there is call for extension of one of the present existing societies or for the formation of a Scottish Moorland Society. State sponsorship may be all right, but scope for the initiative of public-spirited men must be maintained. The individual must co-operate and not just be content with saying, "Why should I? That is a matter for the State."

What Denmark can achieve, Scotland can.

Extract of a lecture delivered by Mr Erik Schacke, Royal Danish Consul-General, Leith, to the Peat Development Association at the Royal Technical College, Glasgow, on October 13, 1950.

REFERENCES: The publications of Det Danske Hedeselskab.

REVIEWS OF BOOKS

EUROPE

Country Lover's Companion : The wayfarer's guide to the varied scenery of Britain and the people who live and work in the countryside. Introduction by BRIAN VESEY-FITZGERALD. 9×6. Pp. 384. 21 colour plates. Photographs. Pictorial maps. London : Odhams Press Ltd, N.D. 15*s*.

Here is a delightful pictorial survey of Great Britain, with no other aim than to show the beauty of the scenery. There are coloured plates and over 300 photographs—illustrations accompanied by short articles on various regions, of which perhaps that on the Cotswold may be noted as particularly happy.

In such a comprehensive but condensed survey minor mistakes must occur, but they hardly detract from the purpose of the book. The Derbyshire Wye ends in the Derwent at Rowsley, not at Matlock, and the road from Sheffield to Hathersage does not cut through limestone unless one goes " to Birmingham by way of Beachy Head." Aberdeen's chief fishing interest is in white fish, not herring. The stones of Stonehenge are not all local : many come from South Wales.

The pictorial maps add to the charm of the book. R. N. R. B.

Afoot in the Hebrides. By SETON GORDON. 9½×6. Pp. 322. 65 illustrations. End-paper sketch maps. London : Country Life Ltd, 1950. 30*s*.

In this delightful volume Mr Seton Gordon deals in turn with all the Hebridean islands, from St Kilda to Islay, though Skye—where his home is—is evidently the favourite of his heart and to it he gives the first half of the book, which necessitates only rather brief or condensed reference to some of the others, such as Barra, Mull, or Islay. The book contains much valuable information on the geography, history, and folklore of the islands from one who has an intimate first-hand knowledge of them all. As might be expected from an ornithologist, there are many interesting and delightful references to bird-life. Modern conditions of life in the islands since the war, which brought aerodromes to some of the most remote parts, are described with sympathy and insight into the character of the people who live there.

For anyone who wishes a true glimpse of the islands in their entirety, no book could be better. There are many excellent illustrations, but a rather more detailed map than the end-papers supplied would have added to the usefulness of the volume. I. W. H.

Quest by Canoe : Glasgow to Skye. By ALASTAIR M. DUNNETT. 8½×5½. Pp. vii+183. Frontispiece. 22 illustrations. 2 sketch maps. London : G. Bell and Sons Ltd, 1950. 12*s* 6*d*.

Some years before the outbreak of the last war, Alastair Dunnett, present editor of the *Daily Record*, made an adventurous journey by canoe, with his friend James S. Adam, from Bowling on the Clyde to Skye. In single-seater canvas canoes the two daring seafarers accomplished what is without doubt one of the most remarkable canoe journeys ever made in Scottish waters. The tale loses nothing in the telling. The description of riding the surf round Seil into Oban harbour is as good a word-picture of the joys of seafaring in a canoe as could be read anywhere. The travellers had some narrow escapes before they beached their frail craft in late autumn at Kyleakin. Everywhere they were met with interest and acclaim, for the trip was undertaken quite frankly with a view to publicity : their daily bread depended upon what they could earn by newspaper articles. Indeed, privacy was not a matter with which they had any sympathy. They gate-crashed shamelessly upon the Isle of Rum, whose proprietor treated them with remarkable forbearance and kindness, though she was surely as much entitled to keep her land private as any other farmer or landowner.

Though the journey's avowed purpose was to interpret the Highlands and stimulate interest in their better commercial development, the author is at his best when he keeps to the journey in hand. His enthusiasm is infectious and his delightful word-pictures should make this unusual book a classic in canoeing adventure. There are many fine illustrations. I. W. H.

Moidart and Morar. By WENDY WOOD. 7½×5. Pp. 216. 2 figs. 26 illustrations. End-paper sketch maps. Edinburgh: The Moray Press, 1950. 10*s*.

The author writes enthusiastically about one of the most beautiful districts of the West Highlands, well known to her from many years residence on her own croft. Though she is apt to ramble at times, and there is often a whiff of what Mr Moray McLaren calls " the sickly smell of neo-Jacobite sentimentality," many interesting legends and tales are preserved in its pages, which will be appreciated by the folklorist. The author has an eye for colour and an apt power of description. The book is illustrated with some excellent photographs. I. W. H.

The Southern Highlands. Edited by J. D. B. WILSON, B.SC. Appendix on the Rock Climbs in the Arrochar District, by B. H. HUMBLE and J. B. NIMLIN. 8½×5½. Pp. xi+204. 44 illustrations. End-paper sketch map. [Scottish Mountaineering Club Guide Books.] Edinburgh : The Scottish Mountaineering Club, 1949. 15*s*.

This is the last of the Scottish Mountaineering Club series to be published. The area is bounded on the south by the Forth and Clyde Canal. The northern boundary is less naturally defined but roughly it follows the railway from Oban to Dalmally, then NE to Bridge of Orchy and north to Rannoch. From there it runs east to Pitlochry and SE to the Firth of Tay. The country covered by the guide is less precipitous than that in its neighbour, *The Central Highlands*, as is at once apparent from the illustrations which are good, apart from a few exceptions.

The guide gives a brief description of the major hills in the district and the means of access and routes, and will be most useful to anyone visiting the district for the first time. There is an article on the geology of the district by Dr J. Phemister. The rock climbs, which are mostly in the Arrochar district, are dealt with in an appendix. A. H.

Newcastle upon Tyne : Its Growth and Achievement. By S. MIDDLEBROOK, M.A. 8½×5½. Pp. xii+361. 46 illustrations. 11 plans and maps. Newcastle upon Tyne : Newcastle Chronicle and Journal Ltd, 1950. 15*s*.

In the preface to this book, the author sets out " to weave together the various strands in the history of Newcastle upon Tyne in a narrative record of continuous growth, the economic development of Tyneside being taken as the main thread." He further makes an effort " to present the growth of the city as an organic part of a wider process of development. . . ." These purposes he succeeds in fulfilling in an engaging style. The material itself is systematically arranged, and as the story unfolds one is conscious of a duality : firstly, the interplay of historical and geographical factors ; secondly, the effects of these elements both locally and nationally. Yet one is not overburdened with detail nor lost in side issues. The resultant work —adequately illustrated—is to be recommended. R. C.

The English Lakes. By ALFRED FURNESS and W. V. HARKE, M.R.C.S., L.R.C.P., D.P.M., R.C.R. & S. Foreword by Sir Patrick Abercrombie, M.A. 11×8½. Pp. x+76 plates. [Immortal Britain, 1.] London : George Allen and Unwin Ltd, 1949. 42*s*.

The illustrations in the first volume of the *Immortal Britain* series are accompanied by apt poetic quotations and occasional explanatory comments. Many of the photographs suffer because of incorrect exposure with loss of detail in the shadows. Whilst some of the photographs do catch something of the grandeur of the Lakes scene, the work as a whole, considering the price, tends to be disappointing. A small map locating the points where the photographs were taken would have been desirable. R. C.

The Face of North-West Yorkshire. By ARTHUR RAISTRICK, PH.D., M.SC., F.G.S., and JOHN L. ILLINGWORTH, M.A. 8×5¼. Pp. vi+106. 10 plates. 2 sketch maps. Clapham, Yorkshire : The Dalesman Publishing Company, 1949. 5*s*.

The authors are to be congratulated on the wealth of detail they have been able to introduce into a book of little more than a hundred pages. They have achieved this by the clarity of their writing and the systematic arrangement of their matter.

The area covered is the region commonly known as the Yorkshire Dales and forms an approximate square of upland country bounded north and south by the Stainmore Gap and the Ribble-Aire valley and west and east by the Lune valley and the outcrop of Magnesian Limestone. A line from Richmond to Skipton roughly bisects the region, Carboniferous Limestone forming the dominant structure of the western half and Millstone Grit of the eastern.

In the section on the geology of the region Dr Raistrick traces the geological history of the Pennines from pre-Cambrian times to the changes wrought by the Ice Age and relates it to the scenery as we know it to-day. Mr Illingworth writes of the plant cover, both past and present, from the point of view of the ecologist, and indicates changes still occurring under the influence of man. Except for a chapter on the mineral wealth and one on the farming pattern, the human history of the region, the siting of settlements, the establishment of communications, etc., are not included.

The ten photographs are aptly chosen, but the diagrams add little if anything to the text. More sketch maps would be of much greater value. There is a useful bibliography. S. C. F.

Off to the Dales : Walking by the Aire, Wharfe, Ure and Swale. By Jessica Lofthouse. $8\frac{1}{2}\times5\frac{1}{2}$. Pp. 314. Drawings by the author. End-paper sketch maps. London : Robert Hale Ltd, 1950. 15*s*.

Amongst the many books on the Yorkshire Pennine Dales this must be given a very high place. It is a book of dale-, fell- and moor-walking in all weathers and at all seasons of the year. The criss-cross pattern of the author's walks, admirably shown on the two end-maps, covers not only the familiar dales such as Wensleydale and Wharfedale, but the lesser known tributary dales, their homely villages and lonely farmsteads, the ancient churches, abbeys, and castles. The character and life of the people, their history, folklore and superstitions, are clearly visible through the pattern, and the reader senses the atmosphere of the dales and can appreciate their magnetic charm for those who know them well. The numerous illustrations from the author's sketch book form an added attraction to this charming book.
S. C. F.

Yorkshire : West Riding. By Lettice Cooper. $8\frac{1}{2}\times5\frac{1}{2}$. Pp. xii+305. 49 photographs. [The County Books.] London : Robert Hale Ltd, 1950. 15*s*.

Although the wool industry occupies only a small part of the area of the West Riding, the author uses it as a simile for this study of Yorkshire life and character, the warp being the physical background on which the pattern of modern life, in both the industrial and the agricultural regions, is woven by the woof of Yorkshire's turbulent history and of the revolutionary changes of more recent times.

The book would be a worthy member of the series of *County Books* were it not marred by numerous inaccuracies and by evidence of slipshod proof-reading. Misprints and errors in place-names and proper names are so frequent that they become irritating, and the irritation is increased by the unhappy use of "she" and "her" in referring to towns and cities. The illustrations are excellent, but the map is unsatisfactory. S. C. F.

The Mersey Estuary. By J. E. Allison, M.A. $8\frac{1}{2}\times5\frac{1}{2}$. Pp. viii+60. 23 maps and diagrams. 9 illustrations. Liverpool : The University Press, 1949. 3*s* 6*d*.

This is a concise, lucid and strictly geographical account of the principal factors in the development of Merseyside. It is a specialised work including no more than is expressed in the title and is not a general port study. Port equipment, landward approaches, traffic and industries receive no more than incidental reference. It is an account, from the geographer's viewpoint, of the physical, historical and economic aspects of the estuary and is particularly illuminating on the development of the ferry services. Copiously illustrated with diagrams of a high cartographic standard and with excellent photographs, it is a valuable contribution to the geographical literature of Merseyside and could well be followed by similar studies such as the estuaries of the Thames, Southampton Water, or Clyde. H. P. W.

Hertfordshire. By Sir William Beach Thomas. 8½×5½. Pp. viii+270. 49 illustrations. Sketch map. [The County Books.] London : Robert Hale Ltd, 1950. 15*s*.

This is an interesting collection of anecdotes, reminiscences and descriptive comments concerning Hertfordshire, written by an author well qualified to write for those who enjoy works on the charm of the countryside or ' regional romance.' Although the book does not deal comprehensively with the county, the engaging, conversational style of its author—so well known a figure in Hertfordshire—helps to convey something of the atmosphere of the countryside, and also to make the book very readable. The author is at his best when writing as a naturalist or when commenting upon the rural human landscape. A generous and interesting selection of photographs has been included. J. S. F.

Buckinghamshire. By E. S. Roscoe. Revised by R. L. P. Jowitt and E. Clive Rouse, f.s.a. 6¼×3¾. Pp. xii+211. 63 illustrations. Map. [The Little Guides.] London : Methuen and Co. Ltd, and B. T. Batsford Ltd. Seventh edition, 1950. 7*s* 6*d*.

Since publication of the original edition in 1903, much additional information has been incorporated in this *Little Guide* without impairing the historical framework so competently delineated by the late author. In the present edition much of the text has been re-written and brought up to date. The introductory matter includes an admirably condensed account, by Sir Aubrey Strahan, of the geology of Buckinghamshire, and of the flora and fauna, by Mr G. Claridge Druce, as well as useful sections on history, antiquities, architecture, communications, and industries. As in other volumes of the series, there are inspissated biographies of people connected with the county and also a bibliography. The description of places, alphabetically arranged, the good illustrations and map also contribute to make this little book welcome both as a guide and for study and reference. J. H. K.

Port of London. By Frank C. Bowen. 9½×7½. Pp. 216. Illustrated. 6 Plans. London : Dryden Periodicals Ltd, 1949. 21*s*.

Primarily intended for those concerned with shipping and commerce, this authoritative reference book is of interest also to the geographer. It contains an excellent account of the history and development of the Port of London, with plans of the docks and basins, and tabulated data relating to distances, bridges, wharves, and tides. The book is well produced and illustrated. J. H. K.

Kent. By Ronald F. Jessup, f.s.a. Based on the original Guide by J. Charles Cox, ll.d., f.s.a. 6¼×3¾. Pp. xii+307. 60 illustrations. Map. [The Little Guides.] London : Methuen and Co. Ltd, and B. T. Batsford Ltd. Seventh edition, 1950. 7*s* 6*d*.

More than 300 pages of information systematically arranged, well printed and illustrated, including an index and good map, and all so compact that it is still really a pocket-book. The work falls into two main divisions. Some 45 pages are given to the introduction composed of chapters dealing with every aspect of the topography of Kent—landscape, flora and fauna, history, antiquities, place names, industry and many other subjects. Every section is of value, and special mention might be made of the care lavished upon the study of the architectural monuments, ecclesiastical and civil, of the county. The greater part of the book is occupied by the description, in alphabetical order, of towns and villages, the exact location of each being indicated by grid reference. R. T. C.

Isle of Wight. By Aubrey de Selincourt. 9×7. Pp. 48. Drawings by Kenneth Rowntree. 51 photographs. 2 maps. [Vision of England.] London : Paul Elek Publishers Ltd, 1948. 9*s* 6*d*.

Attractive reproductions of photographs, drawings, of Speed's map of 1670, and of the Ordnance Survey map on the scale of 4 miles to an inch, amply illustrate the author's observations and personal impressions of scenery and life in parts of the Isle of Wight ignored by the majority of visitors but treasure-trove for cognoscenti. I. E. C.

Snowdonia : The National Park of North Wales. By F. J. North, D.Sc., F.G.S., F.S.A., Bruce Campbell, PH.D., and Richenda Scott, PH.D.(ECON.). 8½×6. Pp. xviii+469. 25 figs. 56 colour plates by John Markham and others. 48 black-and-white photographs. 6 maps. [The New Naturalist, Vol. 13.] London : William Collins, Sons and Co. Ltd, 1949. 21*s*.

Since there existed as yet no comprehensive geographical study of Wales, we must welcome what is fundamentally a geographical study of a restricted, but nevertheless probably the best known, part of the country. The three authors in their physical, ecological, and historical sections respectively maintain the now accepted standard of *The New Naturalist* series and the same may be added for the illustrations. Dr North's presentation of the geology is particularly attractive.

In the comprehensive bibliography, *The Mountains of Snowdonia*, edited by H. R. C. Carr and G. A. Lister, should have been included. It is mentioned on p. 13, but the reference is to the 1925 edition. The new edition of the standard work has been reviewed recently in the *S.G.M.* [1948, 64 (*3*) : 157]. R. M. P.

Turf Beneath My Feet. By Garry Hogg. 8½×5½. Pp. 250. 29 photographs. London : Museum Press Ltd, 1950. 15*s*.

Mr Hogg spent a walking holiday in the west of Ireland. From Glengarriff he traversed the mountains of Kerry, followed the coast of Limerick, crossed the limestone district of Co. Clare, picked his way through the tangled mass of mountain, lake and bog that is Connacht, and emerged triumphantly on the wind-swept coast of northern Donegal. The account of his adventures, personal impressions and observations is written in a leisurely manner. That his book is an expression of the author's personal holiday rather than a reflection of the complete personality of the western sea-board of Ireland should not detract from its enjoyment as a mental relaxation for those not fortunate enough to be on holiday. J. T.

Introduction to Sweden. By Ingvar Andersson and others. Translation by Nils G. Sahlin. 8½×6. Pp. 311. Illustrated. Map. Stockholm : The Swedish Institute, 1949. *Kr.* 12.50.

This finely produced volume takes the place of the *Swedish Year Book*, and is on more readable and less statistical lines. It is, of course, in the nature of a eulogy : everything is ideal. And, indeed, Sweden is a happy and prosperous land if only because it avoided being embroiled in two world wars. The book should be of great value to teachers. R. N. R. B.

Switzerland : A Democratic Way of Life. By André Siegfried. Translated from the French by Edward Fitzgerald. 8×5½. Pp. 223. 18 figs. London : Jonathan Cape Ltd, 1950. 12*s* 6*d*.

The appearance of a work by any acknowledged master of his subject is an event, and of one from the pen of M. Siegfried is no exception. As usual his observations are accurate, analysis penetrating, deductions stimulating, and style easy. Switzerland is his subject, not only the country known and loved by the tourist, but that of the Foreland and Jura as well, of industrial activity and commercial enterprise. From M. Siegfried we learn much of its religious, cultural and political life, its industrial organisation and administrative systems, its achievements and its difficulties. Here is the complement of the innumerable books on mountains and scenic beauties, on sport and gastronomy.

The author is one whose country was far more damaged by war than ours, a fact revealed by his almost pathetic admiration for this prosperous little country. At times this renders him uncritical. Thus no mention is made of the inability to balance the Federal budget through constitutional inability to raise direct taxes. Also self-discipline and empiricism in government will not be unfamiliar to British readers even if Swiss capacity for hard work is.

M. Siegfried could have been better served by his translator. Some passages are rendered obscure, there is a lack of consistency in nomenclature, and surely the author never meant "where the Rhine joins the Inn"? Finally, such an excellent book could surely be provided with a more adequate folding map. H. P. W.

Mediterranean Island. By Lady SHEPPARD. 8½×5½. Pp. 199. 40 illustrations. Decorative end-paper map. London: Skeffington and Son Ltd, N.D. [1949.] 16*s*.

This is a pleasant account of a pre-war sojourn in Majorca and of a brief return in 1946. *Mediterranean Island* is largely the story of an unsophisticated people, but the author has something to say about the island's history. The many illustrations are excellent. C. R. V. G.

ASIA

The Arab of the Desert: A Glimpse into Badawin Life in Kuwait and Sau'di Arabia. By H. R. P. DICKSON. 9¼×6¼. Pp. 648. 78 figs. 57 plates. 10 maps. 6 genealogical tables. Glossary. London: George Allen and Unwin Ltd, 1949. 63*s*.

This is an encyclopaedic work written by a man whose opportunity of living close to the Desert Arab has been quite exceptional. The book is excellently produced and well illustrated. The line drawings by the author's wife are particularly pleasing and of great interest.

One regrets Colonel Dickson's decision not to follow any accepted plan about the spelling of Arabic names. In the foreword he explains that he is trying to convey to his readers the Arabic phrases as they sounded to him. His usage of the symbols *q*, *g*, *j*, *k*, and *ch* are especially confusing, and in several places one is led to the conclusion that he has misheard words and phrases.

Colonel Dickson could well have spared us much of his Arabic. The untranslated song on p. 230, for example, can mean little to the general reader and is only irritating to the Arabist. The translations, too, are unreliable.

Other writers than our present author have tended to romanticise Arabia and lose touch with reality, and it may be that some readers enjoy these flights of fancy. When, however, he sets up as an ideal the Arab world made for males and suggests it as a pattern for the West, others will find this difficult to accept.

Some will feel that the author is equally bemused with " the spell of far Arabia " when he writes on divorce, slavery, blood feuds and camel raiding. We are told that " the Arab is above all a believer in the preservation of appearances." Perhaps if our author could have kept this more in mind, he would not have allowed loyalty to his Arab friends to betray him into an acceptance of their favourite façade attitudes.

Even when it expresses opinions which are difficult to accept, this book makes enjoyable reading, but it is at its best in the description of actual incidents. The vivid picture of a sand-storm in the desert is excellent. The whole chapter on the changing seasons is very good and written with the deep understanding of one who knows from the inside how closely the whole life of a desert people is bound up with the passing of the summer heat and the coming of the rains. In the chapter on locusts, too, Colonel Dickson captures the spirit of a memorable experience and transforms it into a memorable word picture.

As a teller of Arab folk-tales the author is again at his best. The stories are well selected and told with the real flavour of yarns such as camel men spin when seated around the camp fire at night, leaning back on their camel saddles after a long day's journey. Of Arab horses and dogs, of hawking and pearl diving, of boat building and many other interesting sides of Arab life this book is a mine of valuable information. P. W. R. P.

Zum heiligsten Berg der Welt auf Landstrassen und Pilgerpfaden in Afghanistan, Indien und Tibet. By HERBERT TICHY. Foreword by Sven Hedin. 9×6. Pp. 200. 133 photographs. 2 maps. Wien: L. W. Seidel und Sohn. Fourth edition, 1949. *S* 39.50, or $4.00.

The " most sacred " Tibetan mountain is Kailas, several weeks' journey from the Nepalese frontier and beyond the holy lake of Mansarowar and its neighbour Rakas Tal. Disguised as Indian pilgrims, the author—an Austrian student of geology—and his companions walked round this mountain. On the way to the principal goal he spent a few days in climbing to within 2000 feet of the summit (25,350 ft.) of Gurla Mandhata. The visit to Tibet is but one excursion in a remarkable tour

which lasted about a year. It took him twice across India, through Burma, Kashmir, Afghanistan, and Persia. He mostly travelled by motor-cycle and alone.

The author does not claim for his book great scientific value. But it tells a good story of adventure and brings on to the stage people of every class, from maharajas to beggars and thieves. The self-satisfied exuberance that marks the narrative is excusable, for it recounts an achievement calling for exceptional enterprise and courage, and carried to success by a young man of twenty-three.

The brief introduction by Sven Hedin is dated May, 1937. There are two good maps, and the numerous photographs are fresh and interesting. Whatever be its geographical worth, this is a very readable book. R. T. C.

Ceylon, Pearl of the East. By HARRY WILLIAMS. 9½×6. Pp. 460. 33 illustrations. Decorative end-paper maps. London : Robert Hale Ltd, N.D. [1950.] 25*s*.

Ceylon, Pearl of the East, is a notable work and tells the general reader almost everything he is likely to wish to know about the island. Mr Williams is a retired tea-planter and full of love for Lanka—the ancient name for Ceylon and the one he prefers to use. His book falls into two distinct sections, historical and descriptive. The first ranges over twenty-four centuries and includes accounts of the mystic ruins of the ancient capitals, Anuradhapura and Polonnaruha. Unfortunately, though, the later years of British administration and the events culminating in the island being transformed from a Colony into a Dominion are omitted. The descriptions of Lanka to-day, its peoples, cities and scenery, flora and fauna, are excellent. Much space is devoted to the different industries and, very properly, to tea in particular. Mr Williams is at his very best when writing of the psychological conditions under which the tea-planters live and of the mental atmosphere of Colombo—the city which " is not regarded as *home* by any of the people who use it."

Perhaps the most interesting aspect of Ceylon's story is how its peoples have withdrawn from the plains into the hills, leaving four-fifths of the island almost uninhabited. Such a movement, except under stress of war or disease, must be unique, or nearly so. War, indeed, is a partial explanation in this case.

Use of a particular term, invariably employed in Ceylon, is liable to confuse the reader without previous knowledge of the island. The ancient irrigation works are always called ' tanks.' The word, tank, conjures up something no larger than a pond, but the tanks of Ceylon are reservoirs, often thousands of acres in extent.

The book is amply illustrated, but suffers severely from lack of a proper map. The pictorial map inside the cover is no adequate substitute, shows neither roads nor railways, and gives no clue to the location of many places named in the text.

C. R. V. G.

AMERICA

Eskimo Summer. By DOUGLAS LEECHMAN. 8½×5½. Pp. 255. 25 illustrations. London : Museum Press Ltd, 1950. 15*s*.

The first Canadian edition of this attractive account of a summer spent with the Eskimos on Killinek Island was reviewed in the *S.G.M.* [63 (*1*) : 41]. The first English edition, with additional illustrations, is welcome. The absence of maps, however, is regrettable. I. E. C.

BIOGRAPHY

Records and Recollections of Sir James Lamont of Knockdow. By AUGUSTA LAMONT. 9½×6. Pp. 24. 4 plates. Printed for the Clan Lamont Society, 1950.

This memoir had its origin in the biographical sketch published in this *Magazine* in 1946 [62 (*2*) : 76-77], and was written with the help and encouragement of the late Sir Norman Lamont, Bt. The former Laird of Knockdow, Sir James Lamont, had a long and varied career : as a traveller and explorer, sportsman, Member of Parliament, owner of sugar estates in Trinidad, Deputy Lieutenant for the County of Bute, and as a man of wide interests. His daughter's account of the life of this distinguished Fellow of the Royal Scottish Geographical Society will be found acceptable by a circle of readers wider than that for which it was written. J. H. K.

The Life and Times of Sir Julius von Haast, K.C.M.G., PH.D., D.SC., F.R.S., Explorer, Geologist, Museum Builder. By H. F. VON HAAST, M.A., LL.B., LITT.D. 10×6. Pp. xxii+1142. 25 plates. 4 maps. Wellington, N.Z. : H. F. von Haast, 1948. 63*s* (N.Z.).

Readers are indebted to the former Pro-Chancellor of the University of New Zealand for completing his gigantic task—a labour of love—in writing and publishing this account of the life of his distinguished father. It is more than a detailed biography : the book is a very rich mine of information anent the history of civilisation in the antipodean Dominion, more particularly in the province of Canterbury, and reflects the scintillation of scientific life in Victorian England and the Continent of Europe.

Julius Haast was born in Bonn in 1822 and became a British subject three years after his arrival in New Zealand in 1858. The scientific training, particularly in geology, which he had received at the university of his native city and later through association with outstanding scientists, and his own energy and enthusiasm and integrity, were the foundations and guiding influence of his life of exploration and research in New Zealand and of his greatest achievement : the creation and direction of the Canterbury Museum in Christchurch. It was characteristic of the man that the names he proposed for topographical features in the Southern Alps were those of the world's representative scientists—for instance, of Hutton, Playfair, Murchison, J. D. Forbes, and William Landsborough.

Recognition of his status as a savant and citizen were not denied to Julius Haast ; he was laureated at the universities of Tübingen and Cambridge, and received the accolade at Osborne. His sponsors for the Fellowship of the Royal Society were Hooker, Murchison, Huxley, Lyell, and Darwin.

No brief notice could do justice to the contents of the seventy-two chapters of this large work. It may perhaps be argued that it is too large, owing to the inclusion of trivial matter. However, such trivialities are essential to the book as a whole, in mirroring an eminent man and his contemporaries, and the period in which they lived, and in providing the geographer, geologist, naturalist, and historian with a wealth of material for study and reference, and the general reader with excellent entertainment. It is an outstanding book, vividly written, and fascinating.

J. H. K.

Traveller's Prelude. By FREYA STARK. $8\frac{3}{4}\times5\frac{5}{8}$. Pp. xii+346. 24 illustrations. Wood engravings by Reynolds Stone. Sketch map. London : John Murray. First edition, 1950. 18*s*.

Readers of Miss Freya Stark's candid and remarkable autobiography owe a debt of gratitude to Sir Sidney Cockerell, by whose special request it was written, says the author, " during a short lull that came to me in Cyprus." The biography, as the jacket claims, is a very unusual one. It could scarcely fail to be so, for the author's prelude to her famous adventures in Arabia and Persia were pitched in a highly unusual key. Her parents were first cousins and were both gifted artists. The result was not a harmonious one for their two devoted daughters, Freya and Vera. Flora Stark, the mother, eventually left her home to work out her own salvation as a designer at a carpet factory at Dronero in Italy, the land of her own youth, having fallen rather inexplicably under the spell of the Machiavelli of the autobiography, an Italian count who ran the factory and apparently everybody else in his neighbourhood. Of him Miss Stark speaks with bitterness. He eventually married her younger sister Vera—gifted as a sculptress—who died at the age of 26. Miss Stark's father, a loveable artist devoted to Dartmoor and to nature and animals, died a rather lonely exile in British Columbia, where he had bought a fruit-farm which he worked with considerable success, and where he found contentment at the end of his life.

Freya Stark was born in Paris, where her parents were art students, and by the age of three had visited Italy, France, Dartmoor, London and the Dolomites, speaking three languages at the age of five. Her autobiography is as outstanding as her delightful books of travel, and will bring her nearer to her wide circle of admirers. Many well-known names and figures pass through her pages. There is an index, and the illustrations are interesting and excellent.

I. W. H.

GENERAL

This My Voyage. By Tom Longstaff. 8¾×5. Pp. xii+324. 23 plates. 15 sketch maps. London : John Murray, 1950. 21*s.*

Few mountaineers have a wider experience, and none can write of his adventures with greater charm and vividness, than Dr Longstaff. He tells the tale of climbing in many parts of the world and of the conquest of many hitherto unscaled peaks. To one who is no climber some of his victories seem incredible ; to the climber they give useful indication of the route to follow. Relatively late in life his wanderings took Dr Longstaff to Greenland and Spitsbergen more as a naturalist than as a climber and explorer. The chapters on travel in Tibet and Nepal succeed especially in giving the colour and atmosphere of little-known lands, and the Greenland and Spitsbergen pages give a picture of the life of arctic lands, birds and plants and the ever-menacing pack-ice.

The volume is in the first rank of travel books. For a second edition, which assuredly will be asked for, some trifling slips might be corrected : Neale, not Koettlitz, was Leigh Smith's surgeon ; Cagni, not the Duke of the Abruzzi, beat Nansen's northern record ; after Nansen's journey, Nansen did not take the *Fram* through Bering Strait.

There are many excellent photographs and maps. Altogether a delightful book.

R. N. R. B.

MAPS

A Descriptive List of the Printed Maps of Northamptonshire, A.D. 1576-1900. By Harold Whitaker, hon. ph.d. (leeds). 9¾×6. Pp. xvi+216. 13 illustrations. [Northamptonshire Record Society Publications, 1949, Vol. XIV.] Northampton : The Northamptonshire Record Society, 1948. 25*s.* Postage 9*d.*

Dr Whitaker's many contributions to the history of county cartography are invaluable for reference. His annotated list of 691 maps of Northamptonshire, arranged in chronological order, with a tabular alphabetical index, is preceded by a brief survey of English county maps and map catalogues. The list is embellished with reproductions of John Norden's manuscript *Delineation of Northamptonshire* (1591) and of other interesting maps of the county.

J. H. K.

SEVENTEENTH INTERNATIONAL GEOGRAPHICAL CONGRESS

The National Committee of the United States, International Geographical Union, announces the establishment of a special committee to assist geographers who are planning to attend the seventeenth International Geographical Congress to be held in Washington, D.C., in 1952. Dr Clyde F. Kohn, a member of the National Committee, has been appointed Chairman. The purpose of the special committee is to devise ways and means for supplying financial and other help to visiting geographers. It is planned that grants-in-aid and other forms of financial assistance will be provided to a limited number of foreign delegates. These funds will be made available in the United States following the delegates arrival. Whenever feasible, lecture engagements will be arranged for those delegates who wish to avail themselves of such opportunities.

Geographers who wish to attend the Congress, but will need assistance in order to do so, are invited to write to Dr Kohn, Department of Geography, Northwestern University, Evanston, Illinois, U.S.A.

ERRATUM

Owing to a draughtsman's error "Sverdrupbyen" was misplaced on p. 174, *S.G.M.*, 66 (*3-4*). Its position is given correctly in the text.

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

LECTURE SESSION, 1950-51

Owing to an accident to Sir Paul Dukes, K.B.E., the lecture on "The Geographical Factor in Russian History" (see *S.G.M.*, Vol. 66, pp. 189-190) was cancelled in all four centres. In substitution and at short notice :

Thor Heyerdahl lectured on "The Kon-Tiki Expedition" in Glasgow and Edinburgh on 14th and 15th February respectively ;

Andrew C. O'Dell lectured on "Portugal—Land of Contrast" in Aberdeen, 13th February, and

Dr A. B. Flett lectured on "South Uist—The Isle and its People" in Dundee, 12th February.

The thanks of the Society are due to these gentlemen.

OBITUARY

It is with regret that the Society records the death of Prof. Lev Semenovitch Berg in Leningrad on 26th December 1950. Prof. Berg, who was President of the All-Union Geographical Society of the U.S.S.R. and doyen of Russian geographers in both Empire and Soviet Union, was elected Honorary Member and Fellow of our Society in 1947.

In accepting this honour he presented to our library copies of the latest edition of his standard work on physical geography, "Natural Regions of the U.S.S.R." and of his latest book "Outlines of the History of Russian Geographical Discoveries." An American translation of the former, which synthesised 50 years' research in all parts of the Soviet Union, will be reviewed in the next issue.

AMALGAMATION OF AMERICAN SOCIETIES

We are informed by our American corresponding member, Mr H. M. Kendall, Syracuse University, that, as from 1st January 1949, the Association of American Geographers and the American Society of Professional Geographers are functioning as one, under the title of the former. Combined membership totals 1500.

NEWBIGIN PRIZE : 1951 AWARD

A Bronze Medal and Money Prize will be awarded for the best Essay, suitable for publication in *The Scottish Geographical Magazine* and not exceeding 7000 words in length, on any subject relating to the geography of Scotland.

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